Electronic Services - Los Angeles
M10418X

ARBER
OLMAN

1252
IN 42

520 SERIES
TROUBLESHOOTING GUIDE
FOR BENCH SERVICING

INSTRUCTION MANUAL

MP MASTER
MA32114

CONTENTS

Section		Page
1.	Description	3
2.	Main P.C. Board	3
3.	Control Mode P.C. Boards	4
4.	Control Form P.C. Boards	5
5.	Alarm P.C. Boards	10
6.	Options	12
7.	Recommended Spare Parts	12
8.	Pictures Showing Test Points	13
9.	Waveforms	21
10.	Schematics	22
11.	Tables	31

1. DESCRIPTION

This guide is intended for a fairly skilled technician. It includes troubleshooting test points, voltages and possible defects. The technician must have an oscilloscope, a differential voltmeter or equivalent, a millivolt source and a VOM. This guide will not stand alone but must be used with the standard instruction manuals for the Models 521, 522, 523, and 524.

2. MAIN PRINTED CIRCUIT BOARD

2.1 PRELIMINARY

Equipment needed:

1. VOM
2. PA-11 or equivalent.
3. Differential voltmeter or equivalent.

2.1.1 Set-Up

1. Wire rear panel with line cord and PA-11.
2. Plug in 520 with extender.
3. Apply power.

2.1.2 Voltages – Power Supply

Test Point	Voltage	Possible Defect
I to Common	+20 Vdc ±10%	Defective C7, D1, D2, D3, D4, T1.
J to Common	-20 Vdc ±10%	Defective C8, D1, D2, D3, D4, T1.
G to Common*	+15 Vdc ±15 mVdc	Defective IC2, R18. R18 could be out of calibration.
H to Common	-15 Vdc ±10%	Defective D5, Q1.
K to L	22 Vac ±10%	Defective T1.

2.1.3 Voltages – Process Signal ****

A to Common	Always between 10 mV and 100 mV with input set at full range signal.	Defective Range Card.
C to Common**	6 Vdc ±6 mVdc with input signal at center range.	Defective IC1. R8 out of calibration.

2.1.4 Voltages – Setpoint Signal

E to Common	3 Vdc with setpoint at center range.	Defective IC4, Q2, R22. R22 could be out of calibration.
N to Common	0 Vdc when input signal is at setpoint.	Defective IC3.
G to F	+5 Vdc ±5 mVdc	Defective Range Card, IC4, Q2, R22.
B to Common***	+3 Vdc ±3 mVdc with digital setpoint at center range.	Same as 2.1.4.2.

2.1.5 Voltages – Miscellaneous

Process Signal Output	See Section 5
Analog Setpoint	See Section 5
Remote Setpoint	See Section 5
Setpoint Signal Output	See Section 5

*Adjusted by R18.
**Adjusted by R8.
***Adjusted by R22.
****Process meter or deviation meter adjusted for full scale with R10.

3. CONTROL MODE BOARD

3.1 PRELIMINARY

Equipment needed.

1. VOM
2. PA-11 or equivalent.
3. Differential Voltmeter or equivalent.

3.1.1 Proportional Band with Manual Reset (A-10280)

Test Point	Voltages	Possible Defect
Pin 1 to Common	Set mV input to center range. Set setpoint to center range. Set manual reset to 0 Vdc at Pin 3 – Common. Voltage at Pin 1 is then 0 Vdc.	Main board out of calibration. Defective IC5. Defective R23 on main board. Defective manual reset pot.
Pin 2 to Common	+15 Vdc ±15 mVdc	Check Section 2.1.2.3.
Pin 7 to Common	-15 Vdc ±10%	Check Section 2.1.2.4
Pin 8	Common.	

3.1.2 Proportional Band with Automatic Reset (A-10281)

Pin 1 to Common	0 Vdc with input mV set to center range. Reset turned off. Setpoint to center range.	Main board out of calibration. Defective IC5. Defective PB pot.
Pin 2 to Common	+15 Vdc ±15 mVdc	Check Section 2.1.2.3.
Pin 6 to Common	Approximately 5 Vdc ±10% when reset inhibition is used.	Output mode printed circuit board not set up for reset inhibition.
Pin 7 to Common	-15 Vdc ±10%	Check Section 2.1.2.4.
Pin 8	Common.	
Wiper of R2 to Common.	Adjust for 0 Vdc per F-14852, Section 4.3.2	Defective Q1. Defective R2. R2 out of adjustment.

3.1.3 Proportional Band with Automatic Reset and Rate (A-10514)

Pin 1 to Common	0 Vdc with input mV set to center range. Reset turned off. Setpoint set to center range.	Main board out of calibration. Defective IC5; R3 out of calibration.
Pin 2 to Common	+15 Vdc ±15 mVdc	Check Section 2.1.2.3.
Pin 6 to Common	+5 Vdc ±10% when reset inhibition is used.	Output mode printed circuit board not set up for reset inhibition.
Pin 7 to Common	-15 Vdc ±10%	Check Section 2.1.2.4.
Pin 8	Common.	
Wiper of R3 to Common.	Adjust for 0 Vdc per F-14852, Section 4.4.2.	Defective Q1. Defective Q2. Defective IC5.

4. CONTROL FORM PC BOARDS

4.1 VOLTAGE CHECKS

4.1.1 Time-Proportioning (A-10282)

Test Point	Voltages	Possible Defect
Pin 2 to Common	Demand signal (+6 to -6 Vdc)	Check Sections 2 and 3.
Pin 3 to Common	5.5 Vdc ±5% when reset inhibition is used.	Check R1 (if used).
Pin 5 to Common	-15 Vdc ±10%	Check Section 2.1.2.4.
Pin 6 to Common	+15 Vdc ±15 mVdc	Check Section 2.1.2.3.
Pin 7	Common.	
Pin 9 to Common	15 Vac ±10%	Check transformer on main board.
Pin 12	Load line 1	
Pin 14	Output 1	Q2, RC1, T1. Check 4.1.1.11.
Pin 3 of IC1 to Common	Demand signal (when pin 3 of IC1 is higher than pin 2 of IC1, pin 6 of IC1 will be high. When pin 3 of IC1 is lower than pin 2 of IC1, pin 6 of IC1 will be low.)	Check 2.1.4.2. IC1, R2, R3, C1, C3, R4, R5, R6, R7.
Collector of Q1 to Common	When pin 6 of IC1 is high, the collector of Q1 will be low (less than 1 Vdc). When pin 6 of IC1 is low, the collector of Q1 will be high (more than +12 Vdc).	Q1.
Pin 1 of T1 to Pin 2 of T1	See Figure 9.1.	D1, T1, Q1. Transformer on main board.

4.1.2 Single Current Output (A-10283 and A-10284)

Pin 2 to Common	Demand signal (+6 to -6 Vdc)	Check Sections 2 and 3.
Pin 3 to Common	5.5 Vdc ±5% (when reset inhibition is used)	Check R1 if used.
Pin 5 to Common	-15 Vdc ±10%	Check Section 2.1.2.4.
Pin 6 to Common	+15 Vdc ±15 mVdc	Check Section 2.1.2.3.
Pin 7	Common.	
Pin 8 to Common	15 Vac ±10%	Check transformer on main board.
Pin 9 to Common	15 Vac ±10%	Check transformer on main board.
Pin 10 to Pin 11	22 Vac ±10%	Check transformer on main board.
Pin 14 to Pin 16	Current output	Q2, C3, D8, T1.
Collector of Q1 to Pin 6	120 Hz square wave. Amplitude changes with demand signal.	Q1, D3, D1, D2. Transformer on main board.
Across C4	30 Vdc ±10%	D4, D5, D6, D7. Transformer on main board.
Across C3	DC variable with demand	C3, D8, T1.

4.1.3 ON-OFF Output (A-10335)

Test Point	Voltages	Possible Defect
Pin 1 to Common	Deviation Signal	Check Section 2.
Pin 5 to Common	-15 Vac ±10%	Check Section 2.1.2.4.
Pin 6 to Common	+15 Vdc ±15 mVdc	Check Section 2.1.2.3.
Pin 7.	Common.	
Pin 9 to Common	15 Vac ±10%	Transformer on main board.
Pin 12	Load line 1	
Pin 14	Output 1	Q2, T1.
Pin 3 of IC1 to Pin 2 of IC1.	When pin 3 of IC1 is more positive than pin 2 of IC1, pin 6 will approach +15 Vdc and Q1 will turn on, allowing Q2 to turn on. When pin 3 of IC1 is more negative than pin 2 of IC1, pin 6 will approach -15 Vdc and Q1 will turn off, turning Q2 off.	IC1
Pin 1 of T1 to Common	See Figure 9.1	Transformer on main board. D4, T1, Q1, D9.

4.1.4 Time-Proportioning plus ON-OFF (A-10336)

Pin 1 to Common	Deviation signal	Check Section 2.
Pin 2 to Common	Demand signal	Check Sections 2 and 3.
Pin 3 to Common	Reset inhibition (voltage set by value of R9)	Check R9 (if used).
Pin 5 to Common	-15 Vdc ±10%	Check Section 2.1.2.4.
Pin 6 to Common	+15 Vdc ±15 mVdc	Check Section 2.1.2.3.
Pin 7	Common.	
Pin 8 to Common	15 Vac ±10%	Transformer on main board.
Pin 9 to Common	15 Vac ±10%	Transformer on main board.
Pin 12 to Common	Load line 1	
Pin 13 to Common	Load output 2 (on-off)	Q3, T2. Check 4.1.4.15.
Pin 14 to Common	Load output 1 (T.P.R.)	Q2, T1. Check 4.1.4.14.
Pin 15	Ground	
W/Scope from (+) C1, (+) C2 to Common	See Figure 9.3	IC1, C1, C2, R7.
W/Scope across pin 1 to pin 2 of T1, and pin 3 of IC1 positive with respect to pin 2 of IC1.	See Figure 9.1	D1, T2, Q1. Transformer on main board.
W/Scope across pin 2 to pin 1 of T2 and pin 3 of IC2 more positive than pin 2 of IC2.	See Figure 9.1	D2, T2, Q4. Transformer on main board.

4.1.5 Current plus ON-OFF (A-10338 and A-10339)

Test Point	Voltages	Possible Defect
Pin 1 to Common	Deviation Signal	See Section 2.1.4.
Pin 2 to Common	Demand Signal	See Sections 2 and 3.
Pin 3 to Common	Voltage set by value of R1 (normally 5 Vdc ±10%)	Check R9 (if used).
Pin 5 to Common	-15 Vdc ±10%	See Section 2.1.2.4.
Pin 6 to Common	+15 Vdc ±15 mV	See Section 2.1.2.3.
Pin 7	Common.	
Pin 8 to Common	15 Vac ±10%	Transformer on main board.
Pin 9 to Common	15 Vac ±10%	Transformer on main board.
Pin 10 to Pin 11	30 Vac ±10%	Transformer on main board.
Pin 12	Load 2 Line 1	
Pin 13	Load 2 output	Q4, T2. See Section 4.1.5.18.
Pin 14 to Pin 16	Current output	D4, Q3, D6, D7, D8. See Section 4.1.5.16. See Section 4.1.5.15. See Section 4.1.5.17.
Pin 15	Ground	
Junction of R2 and C1 to Common	See Figure 9.2	D1, D2. Transformer on main board.
+15 Vdc supply to pin 2 of T1	Square wave (120 Hz) whose amplitude is proportional to the Demand signal.	D3, Q1. See Section 4.1.5.15.
(+) of C3 to (–) of C3	DC voltage proportional to the square wave in step 15.	D4, T1. See Section 4.1.5.15. See Section 4.1.5.14.
(+) of C7 to (–) of C7	40 Vdc ±10%	FWB1, C7. Transformer on main board.
Pin 1 of T2 to pin 2 of T2.	See Figure 9.1 (this is for the ON state; pin 5 of IC1B more positive than pin 6 of IC1B).	D5, T2, Q2, IC1. Transformer on main board.

4.1.6 Dual Time-Proportioning (A-10337)

Pin 2 to Common	Demand signal	See Sections 2 and 3.
Pin 3 to Common	DC voltage set by value of R10 (normally 5 Vdc ±10%)	R10 (if used).
Pin 5 to Common	-15 Vdc ±10%	See Section 2.1.2.
Pin 6 to Common	+15 Vdc ±15 mV	See Section 2.1.2.
Pin 7	Common.	
Pin 8 to Common	15 Vac ±10%	Transformer on main board.
Pin 9 to Common	15 Vac ±10%	Transformer on main board.
Pin 12	Load line 1	
Pin 13	Load output 2	Q4, T2. See Section 4.1.6.18. See Section 4.1.6.6.
Pin 14	Load output 1	Q2, T1. See Section 4.1.6.7. See Section 4.5.6.15.

(Continued on page 8)

4.1.6 (Cont.)

Test Point	Voltages	Possible Defect
Pin 15	Ground	
(+) of C8 and C9 to Common	See Figure 9.4	C8, C9, Q5, R24. +15 Vdc Supply
Pin 7 of IC1 to Common	See Figure 9.4 (IC1B is a unity gain amp.)	IC1. See Section 4.1.6.12.
Demand Signal vs. Ramp	When the Demand signal is more than 5 Vdc with respect to common, pin 3 of IC1 will be constantly more positive than pin 2 of IC1 causing the output at pin 1 of IC1 to be high (+10 Vdc or more) which turns on Q1. As the demand signal approaches 0 Vdc with respect to common the output at pin 1 of IC1 will be high only for that period of time that the demand signal is more positive than the ramp voltage at pin 2 of IC1.	IC1. See Section 4.1.6.12.
Pin 1 to pin 2 of T1	See Figure 9.1	D1, T1, Q1. Transformer on main board.
Pin 7 of IC2 to Common	See Figure 9.5	IC2, R21. See 4.1.6.12.
Pin 1 of IC2 to Common	If the demand signal is some positive voltage, the ramp signal will add to it to keep pin 2 of IC2 more positive than pin 3 of IC2 which will keep pin 1 of IC2 low (-10 to -15 Vdc) and Q3 turned off. As the demand signal goes negative, pin 1 of IC2 will be positive until the ramp voltage (at pin 7 of IC2) and the demand signal add algebraicly to a positive voltage.	IC2. See 4.1.6.16.
Pin 2 of T2 to pin 1 of T2	See Figure 9.1	D2, T2, Q3. Transformer on main board.

4.1.7 Current plus Time-Proportioning (A-10340 and A-10341)

Pin 2 to Common	Demand Signal	See Sections 2 and 3.
Pin 3 to Common	Voltage is set by the value of R12 (normally 5 Vdc ±10%)	R12 (if used).
Pin 5 to Common	-15 Vdc ±10%	See Section 2.1.2.
Pin 6 to Common	+15 Vdc ±15 mV	See Section 2.1.2.
Pin 7	Common.	
Pin 8 to Common	15 Vac ±10%	Transformer on main board.
Pin 9 to Common	15 Vac ±10%	Transformer on main board.
Pin 10 to pin 11	30 Vac ±10%	Transformer on main board.
Pin 12	Load 2 Line 1	
Pin 13	Load 2 output	Q5, T2. See Section 4.1.7.21.
Pin 14 to pin 16	Current output	D5, D6, D7, Q2, D4, T1. See Section 4.1.7.14. See Section 4.1.7.16.
Pin 15	Ground	

(Continued on page 9)

4.1.7 (Cont.)

Test Point	Voltages	Possible Defect
Junction of D1, D2, R1 to Common	120 Hz full wave	D1, D2. Transformer on main board.
(+) 15 Vdc to pin 2 of T1	120 Hz square wave variable in amplitude in proportion to demand signal.	See Section 4.1.7.13. C1, C11, D3, Q1.
(+) of C3 to (—) of C3	DC voltage whose amplitude is proportional to the demand signal.	D4, T1. See Section 4.1.7.14.
(+) of C4 to (—) of C4	40 Vdc ±10%	FWB 1. Transformer on main board.
(+) of C5, C6 to Common	See Figure 9.4	C5, C6, Q3, R25.
Pin 7 of IC2 to Common	See Figure 9.5	IC2, D8, R14.
Pin 2 of IC2 to Common	This point is the sum of the ramp (pin 7 of IC2) and the demand signal. If the demand signal is positive the sum will be positive. When the demand signal is 0 Vdc, the sum will still be positive as the ramp is always above 0. As the demand signal goes negative, pin 2 of IC2, will be negative for that period of time that it takes for the ramp to get to an equal and opposite voltage.	See Sections 2 and 3. See Section 4.1.7.18.
Pin 1 of IC2 to Common	When pin 2 of IC2 is positive, pin 1 of IC2 will be negative. When pin 2 of IC2 is negative, pin 1 of IC2 will be positive.	See Section 4.1.7.19. IC2
Pin 1 of T2 to pin 2 of T2	See Figure 9.1. This is for that period of time that pin 1 of IC2 is positive.	D10, T2, Q4. Transformer on main board. See Section 4.1.7.20.

4.1.8 Limitrol (A-10371 and A-10460)

Pin 1 to Common	Deviation signal	See Section 2.1.4.
Pin 5 to Common	-15 Vdc ±10%	See Section 2.1.2.
Pin 6 to Common	+15 Vdc ±15 mVdc	See Section 2.1.2.
Pin 7	Common.	
Pin 10 to Pin 11	30 Vac ±10%	Transformer on main board.
Pin 15	Ground	
(+) of C6 to Common	40 Vdc ±10%	See Section 4.1.8.5. FWB1
Pin 6 of IC1 to Common	When power is first applied to the control pin 6 of IC1 will go negative. Even though the deviation signal will be positive, pin 6 of IC1 will stay negative due to the forward biasing of D1 and the fact that R3 is shorted. When S1 is pushed, adding R3 to the feedback, pin 6 of IC1 will swing positive turning on Q1 and K2. IC1 is now running open-loop gain due to the reverse biasing of D1. When the temperature reaches setpoint, the deviation signal will start going negative and cause pin 6 of IC1 to swing to negative turning off Q1 and K2. It will stay negative until S1 is again depressed.	Check jumper connections at A, B, C, and D.

(Continued on page 10)

4.1.8 (Cont.)

Test Point	Voltages	Possible Defect

Limitrol (A-10460) – This is the same as the (A-10471) with the addition of K1 normally open contacts in place of J1. All troubleshooting voltages remain the same with the addition of:

Junction of R8, C7 to Common	When power is first applied to the control, this voltage is (+) .7 Vdc. As C7 charges this voltage goes down, until C7 is charged fully and the voltage across R8 is 0.	Check +15V supply (Section 2.1.2). C7, Q3.
Collector of Q3 to Common	As long as the voltage across R8 is (+) .7 Vdc, Q3 will be turned on and the collector will be approximately +.2 Vdc. When C7 gets charged and the voltage across R8 drops below .7 Vdc, Q3 will turn off and the collector will go to 6 to 8 Vdc.	Q3, C7.
Emitter of Q4 to Common	When power is first applied and Q3 is turned on, the voltage at the emitter of Q4 will be 0 and K1 will be turned off. When C7 finally charges up and Q3 turns off, the voltage at the emitter of Q4 will be between 5 and 8 Vdc and K1 will be energized.	K1, D10, Q4. See Section 4.1.8.10.

5. ALARM PRINTED CIRCUIT BOARD

5.1 PRELIMINARY Equipment needed:

1. VOM
2. PA11 or equivalent
3. Differential voltmeter or equivalent

5.1.1 Deviation Alarm (A-10285)

Test Point	Voltages	Possible Defect
Pin 2 to Common	Adjustable from -3 to +3 Vdc with alarm pot	Defective R1, R2, or alarm pot.
Pin 4 to Common	Deviation Amplifier (IC3) signal.	
Pin 6 to Common	-15 Vdc ±10%	Check Section 2.1.2.4.
Pin 7 to Common	+15 Vdc ±15 mVdc	Check Section 2.1.2.3.
Pin 8	Common.	
Pin 9 to Common	+20 Vdc ±10%	Check Section 2.1.2.1.
Pin 12	120 Vac supply for alarm light.	
Pin 6 of IC1 to Common	1. When Pin 3 of IC1 is more positive than pin 2 of IC1, pin 6 will be more than +10 Vdc. 2. When pin 3 of IC1 is more negative than pin 2 of IC1, pin 6 will be more negative than -10 Vdc.	Defective IC1
Collector of Q1 to Common	1. When step 8.1 above is true, collector will be low (approximately +.2 Vdc). 2. When step 8.2 above is true, collector will be high (more than +12 Vdc).	Defective Q1.

5.1.2 Process Alarm (A-10286)

Test Point	Voltages	Possible Defect
Pin 2 to Common	Adjustable from +2 to +10 Vdc by alarm pot.	Defective R1, R2, or alarm pot.
Pin 5 to Common	+2 to +10 Vdc process signal	Check Section 2.1.3.2.
Pin 6 to Common	-15 Vdc ±10%	Check Section 2.1.2.4.
Pin 7 to Common	+15 Vdc ±15 mV	Check Section 2.1.2.3.
Pin 8	Common.	
Pin 9 to Common	+20 Vdc ±10%	Check Section 2.1.2.1.
Pin 12	120 Vac supply for alarm light.	
Pin 6 of IC1	1. When pin 3 of IC1 is more positive than pin 2 of IC1, pin 6 of IC1 will switch positive (+12 Vdc or more). 2. When pin 3 of IC1 is more negative than pin 2 of IC1, pin 6 of IC1 will switch negative (-12 Vdc or less).	Defective IC1.
Collector of Q1 to Common	1. If pin 6 of IC1 is positive, the collector of Q1 will be low (+.2 Vdc or less). 2. If pin 6 of IC1 is negative, the collector of Q1 will be high (+12 Vdc or more).	Defective Q1.

5.1.3 Deviation Band Alarm (A-10416)

Pin 2 to Common	Adjustable from approximately .05 to +2.4 Vdc.	Defective R1, R2, or alarm pot.
Pin 4 to Common	Deviation amplifier (IC3) signal	
Pin 6 to Common	-15 Vdc ±10%	Check Section 2.1.2.4.
Pin 7 to Common	+15 Vdc ±15 mVdc	Check Section 2.1.2.3.
Pin 8	Common.	
Pin 9 to Common	+20 Vdc ±10%	Check Section 2.1.2.1.
Pin 12	120 Vac supply for alarm light.	
Pin 1 of IC1 to Common	1. When pin 3 of IC1 is more positive than pin 2 of IC1, pin 1 will switch positive (+12 Vdc or more). 2. When pin 3 of IC1 is more negative than pin 2 of IC1, pin 1 will switch negative (-12 Vdc or more).	Defective IC1.
Collector of Q1 to Common	1. When pin 1 of IC1 goes positive, the collector of Q1 will go low (+2 Vdc). Relay energized. 2. When pin 1 of IC1 goes negative, the collector of Q1 will go high (+12 Vdc). Relay de-energized.	Defective Q1.

6. OPTIONS (Refer to Figure 6.1 and Figure 6.2)

6.1 PROCESS SIGNAL OUTPUT

6.1.1 Input at (R) to Common — +2 to +10 Vdc Process Signal

6.1.2 Output at (S) to Common — +1 to +5 Vdc

6.2 TROUBLESHOOTING PROCESS SIGNAL OUTPUT VOLTAGES

6.2.1 If input at (R) is good and output at (S) is not exactly 1/2 of (R), IC6 is defective.

6.3 SETPOINT OPTIONS (ANALOG)

6.3.1 Analog setpoint (Option 1)

6.3.1.1 R4 is setpoint pot.

6.3.1.2 R5 is adjustment for low end of setpoint pot (+1 Vdc).

6.3.1.3 R2 is adjustment for high end of setpoint pot (+5 Vdc).

6.3.2 Analog setpoint with Remote/Local switch (option 2).

This is the same as 6.3.1 with the addition of a switch to enable the use of an external +1 to +5 Vdc setpoint signal.

6.3.3 Analog setpoint with output setpoint voltage (option 3).

This is the same as 6.3.1 with the addition of a unity gain amplifier (IC7) to take the setpoint voltage to the rear connector panel for computer or master-slave operation.

6.4 SETPOINT OPTIONS (Digital)

6.4.1 Digital Setpoint (Option 4)

6.4.1.1 See Sections 2.1.4 and 2.2 for voltages.

6.5 DIGITAL SETPOINT WITH REMOTE/LOCAL SWITCH (OPTION 5)

6.5.1 Same as 6.4.1.1 with the addition of a switch to enable use of an external +1 to +5 Vdc setpoint signal.

6.6 DIGITAL SETPOINT WITH OUTPUT SETPOINT VOLTAGE (OPTION 6)

This is the same as 6.3.1.1 with the addition of a unity gain amplifier (IC7) to take the setpoint voltage to the rear connector panel for computer master-slave operation.

6.7 SETPOINT OPTION (REMOTE ONLY)

6.7.1 Remote setpoint (Option 7)

6.7.1.1 Connects +1 to +5 Vdc external setpoint signal to comparator amplifier IC3.

6.7.2 Remote setpoint with trim (Option 8) (Figure 6.2)

6.7.2.1 Connects +1 to +5 Vdc external setpoint signal to amplifier (IC1) which has a secondary setpoint trim adjust (R8) which can adjust up to 4% offset.

7. RECOMMENDED SPARE PARTS

7.1 MAIN BOARD

7.1.1 Transistors:

2N412	(EYZP-23)
HS5819	(31-162)

7.1.2 Integrated Circuits:

725C	(31-1014)
723C	(31-1010)
714C	(31-1012)

7.1.3 Diodes:

SG-3087	(EYZP-384)
15V Zener	(37-204)

7.1.4 Pots:

50K	(29-380)
5K	(29-374)
100K	(29-220)
3K	(BYZR-162-5)
1K	(29-383)
25K	(29-370)

7.2 PRINTED CIRCUIT BOARD ASSEMBLIES:

7.2.1 Analog Setpoint Assembly (A-10503)

7.2.2 Control Mode Assemblies

7.2.2.1 Manual Reset (A-10280)
7.2.2.2 Auto Reset (A-10281)
7.2.2.3 P.B. with Auto Reset and Rate (A-10514)

7.2.3 Alarm Mode Assemblies:

7.2.3.1 Deviation Band Alarm (A-10416)
7.2.3.2 Deviation Alarm (A-10285)
7.2.3.3 Process Alarm (A-10286)

7.2.4 Output Mode Assemblies:

7.2.4.1 Time Proportioning (A-10282)
7.2.4.2 2-12 mA Output (A-10283)
7.2.4.3 4-20 mA Output (A-10284)
7.2.4.4 On/Off Output (A-10335)
7.2.4.5 Time Proportioning with On/Off (A-10336)
7.2.4.6 Dual Time Proportioning (A-10337)
7.2.4.7 2-12 mA with On/Off (A-10338)
7.2.4.8 4-20 mA with On/Off (A-10339)
7.2.4.9 2-12 mA with Time Proportioning (A-10340)
7.2.4.10 4-20 mA with Time Proportioning (A-10341)
7.2.4.11 Limitrol (A-10371)

7.3 DIGITAL THUMBWHEEL SWITCH*

	Switch	Resistor Network
7.3.1 Units Digit	**32-394**	**90-1963**
7.3.2 Tens Digit	**32-394**	**90-1964**
7.3.3 Hundreds Digit	**32-394**	**90-1965**
7.3.4 Thousands Digit	**32-394**	**90-1966**

7.4 METERS

7.4.1 Process meter without scale (36-092)**

7.4.2 Deviation meter with 50-0-50 scale (36-093-100)***

7.4.3 External process meter kit (71-567)****

*For troubleshooting resistor networks, see Table 11.2.

**Process meter can be ordered two ways:

1. Without a scale (36-092) and:
   a. Use the scale from the defective meter; or
   b. Order the proper scale with the part numbers in Table 11.1.
2. With a scale (36-1XXXX) where XXXX is the four digit range code, e.g., 0—500 F type J (36-10015).

***To order with other deviation scales, see Table 11.3.

****Specify range when ordering.

8. PICTURES SHOWING TEST POINTS

(Pages 13 thru 20)

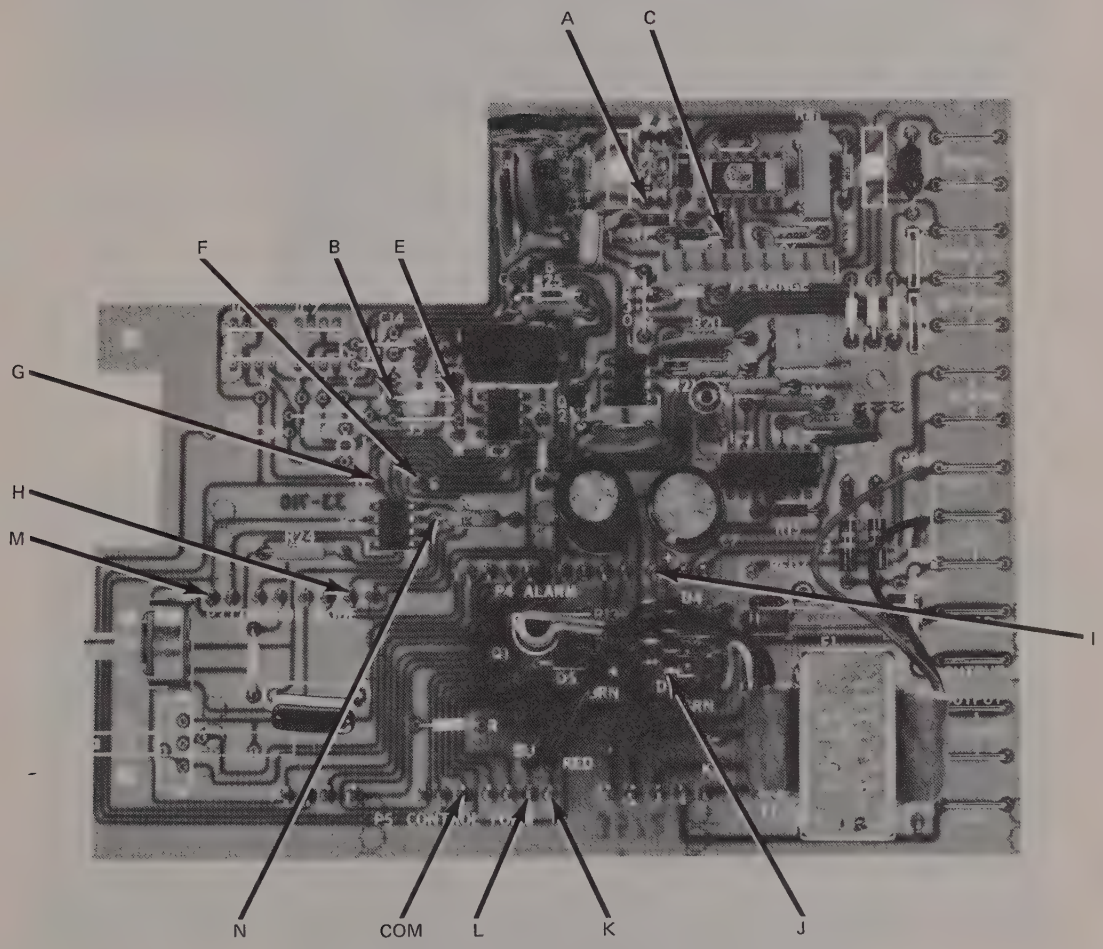


Figure 8.1. Main Printed Circuit Board
(A-10361-200)

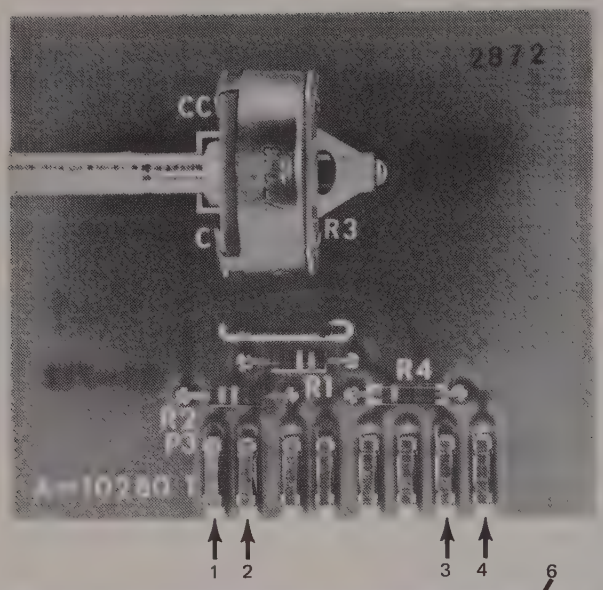


Figure 8.2. Manual Reset
(A-10280)

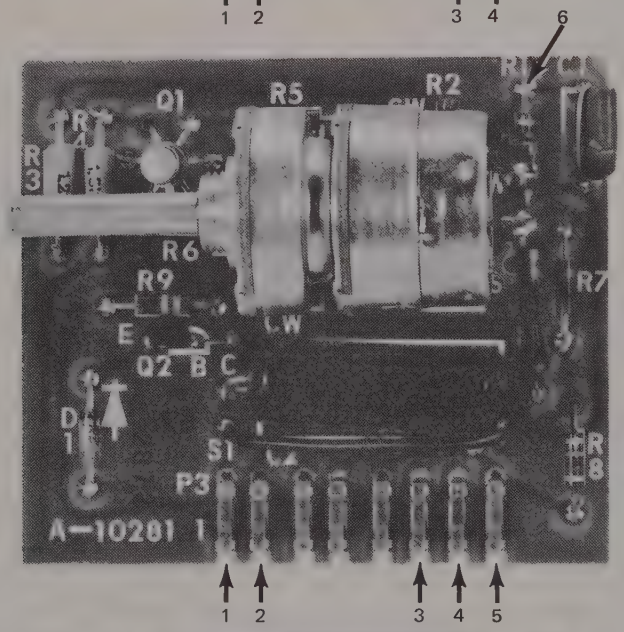


Figure 8.3. Auto Reset
(A-10281)

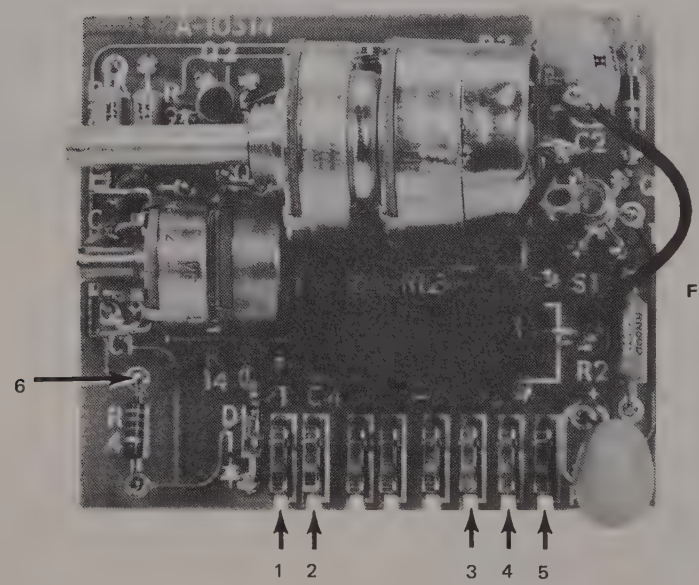


Figure 8.4. Auto Reset plus Rate
(A-10514)

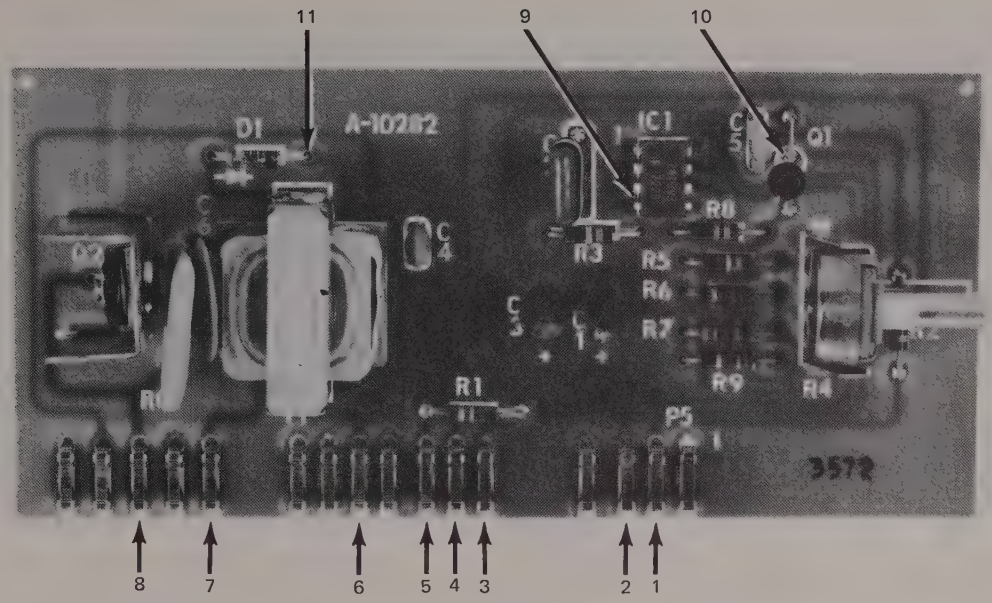


Figure 8.5. Time Proportioning Output (A-10282)

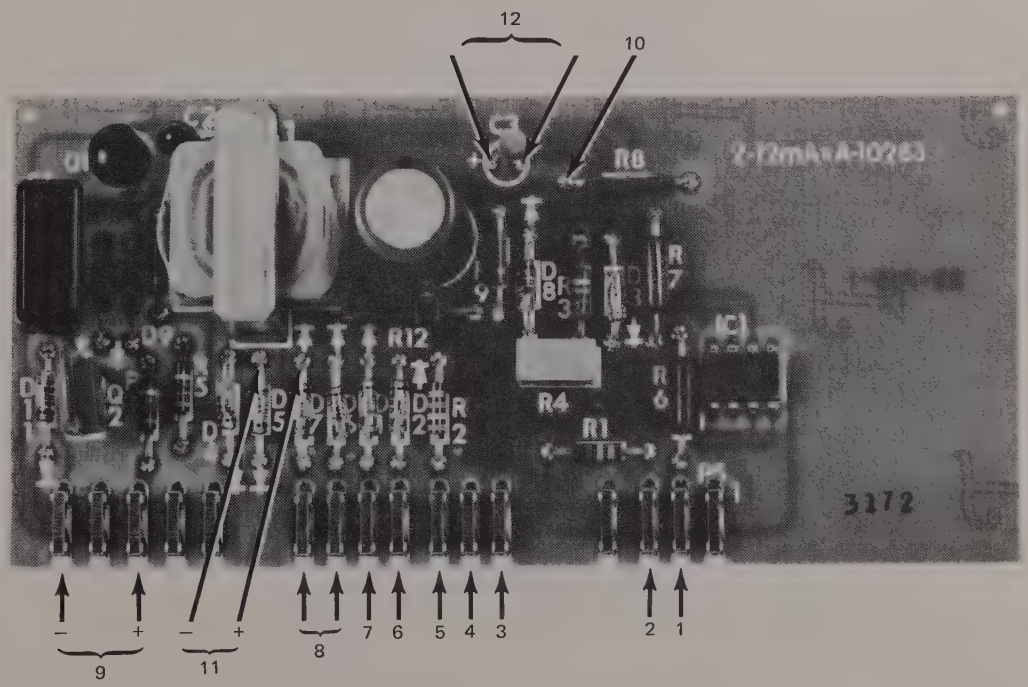


Figure 8.6. Current Output (A-10283 & A-10284)

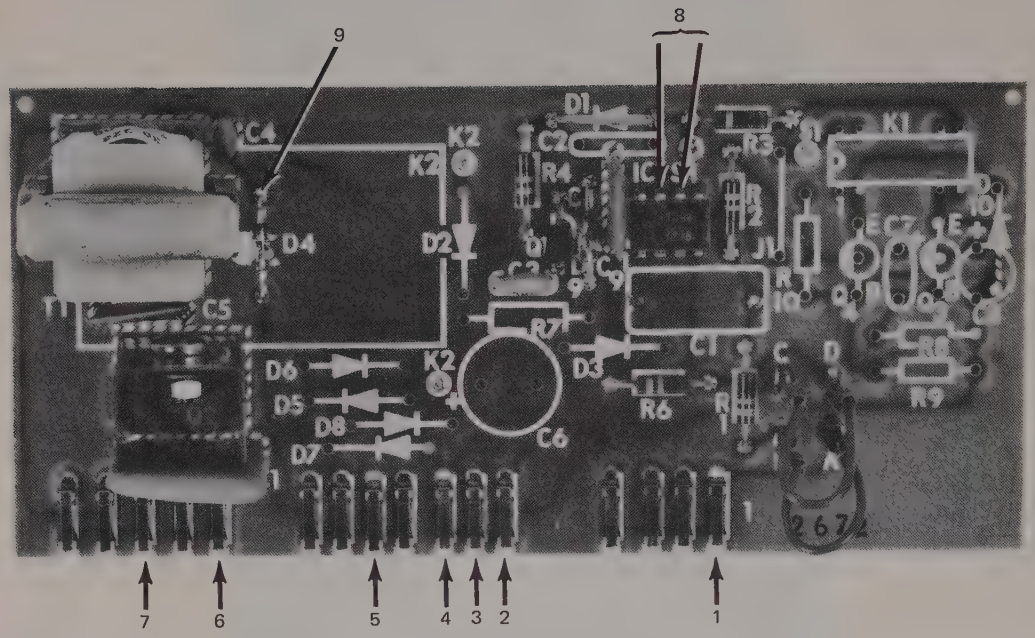


Figure 8.7. ON-OFF Output (A-10335)

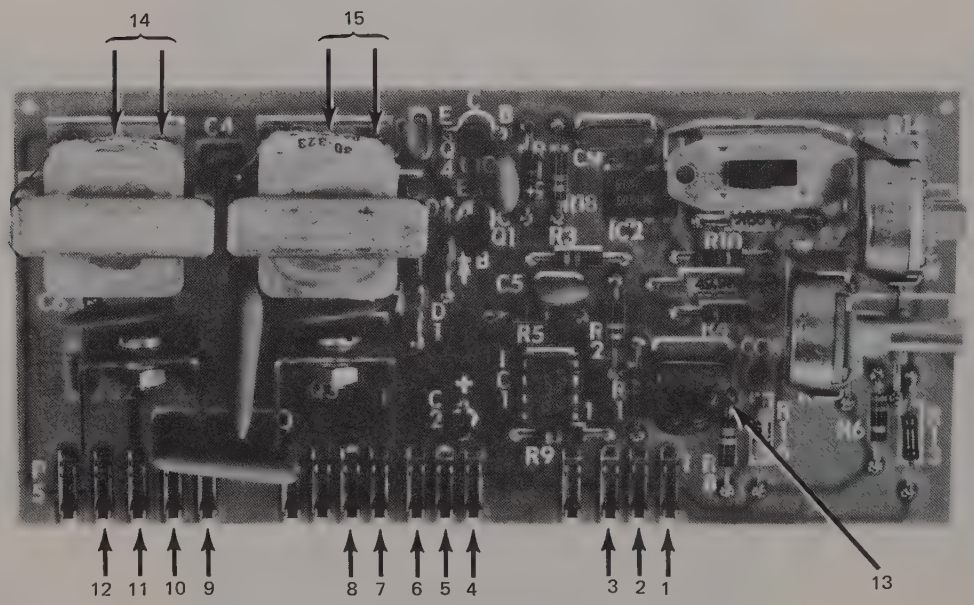


Figure 8.8. Time-Proportioning plus ON-OFF (A-10336)

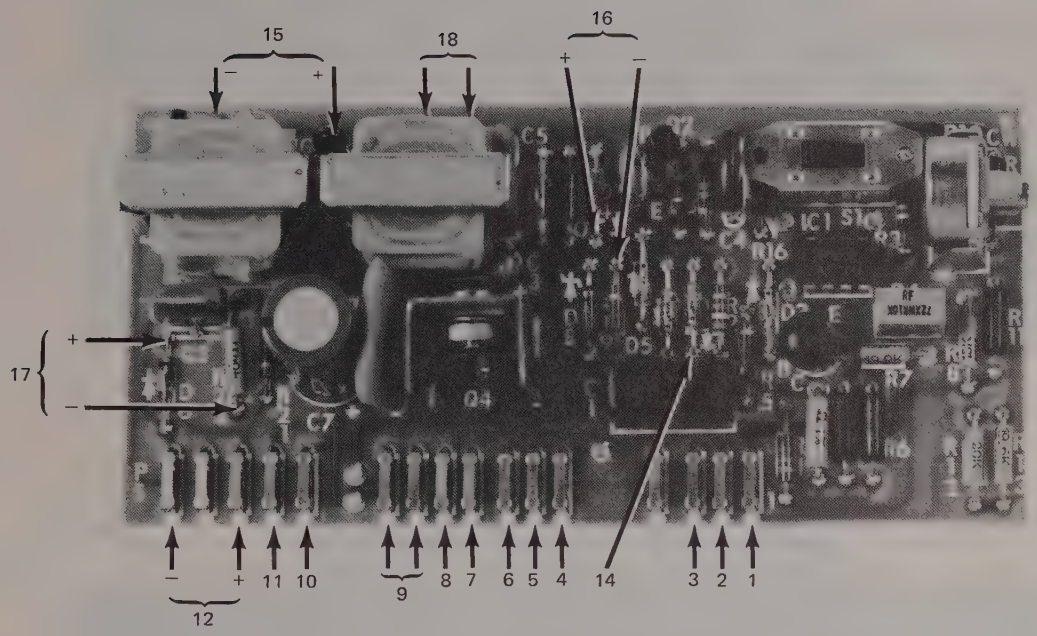


Figure 8.9. Current plus ON-OFF (A-10338 & A-10339)

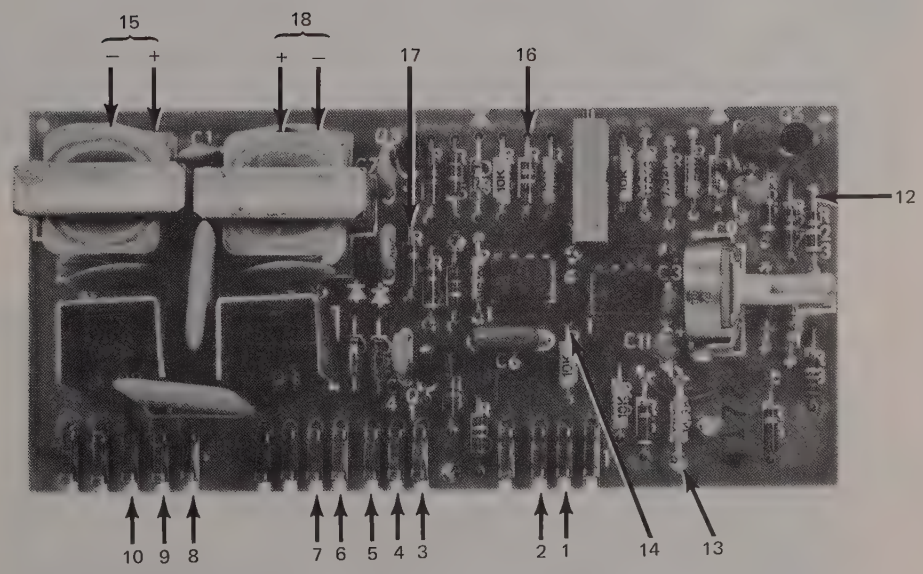


Figure 8.10. Dual Time-Proportioning (A-10337)

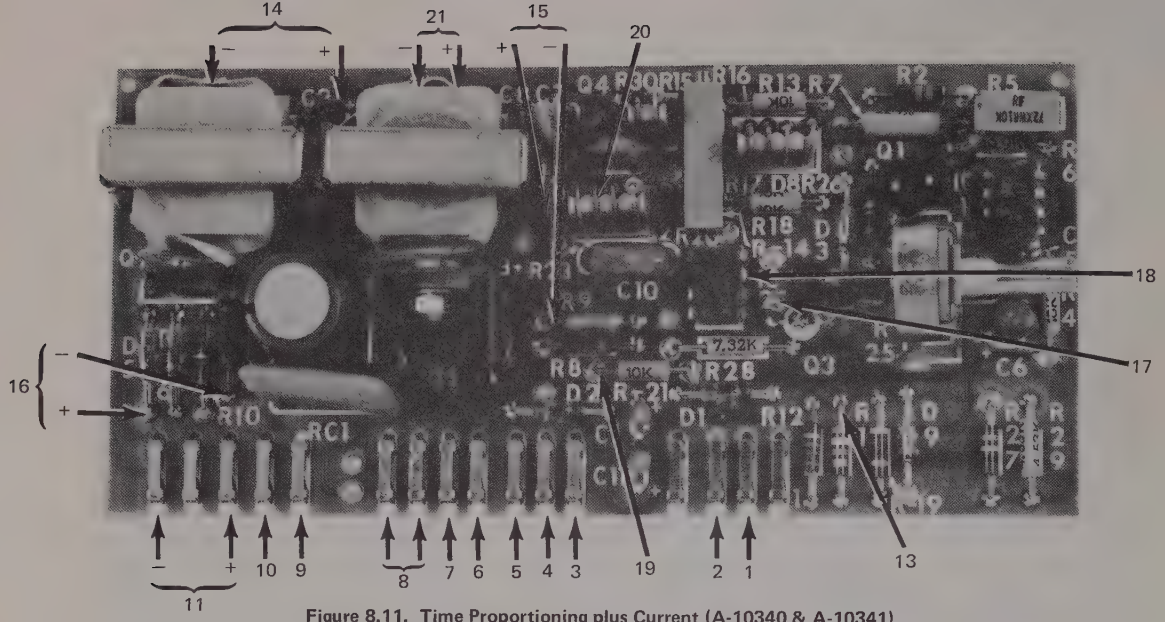


Figure 8.11. Time Proportioning plus Current (A-10340 & A-10341)

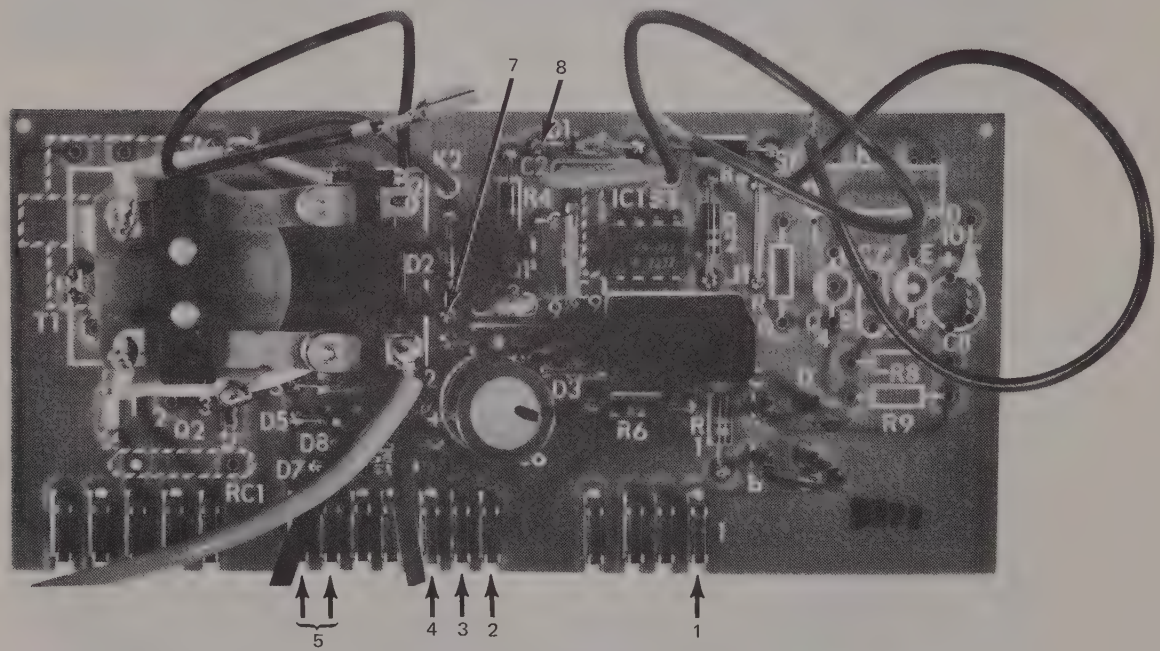


Figure 8.12. Limitrol (L) (A-10371)

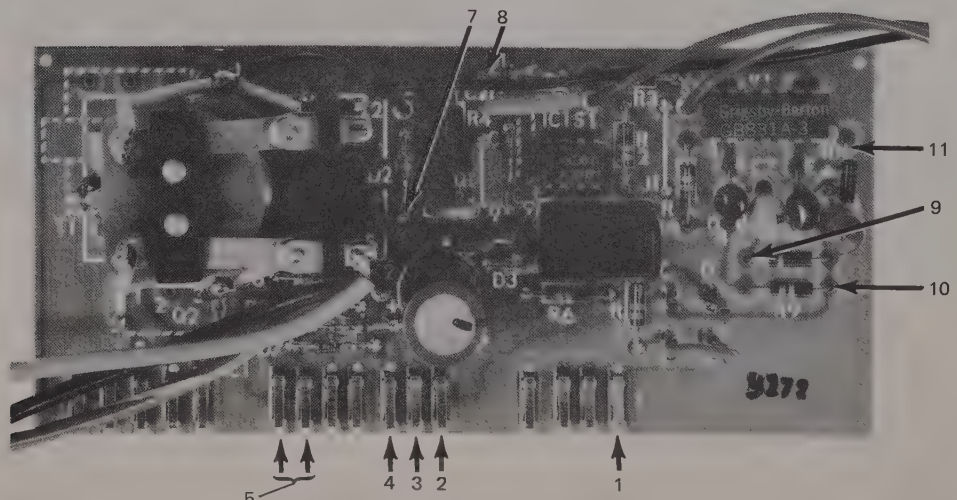


Figure 8.13. Limitrol (T) (A-10460)

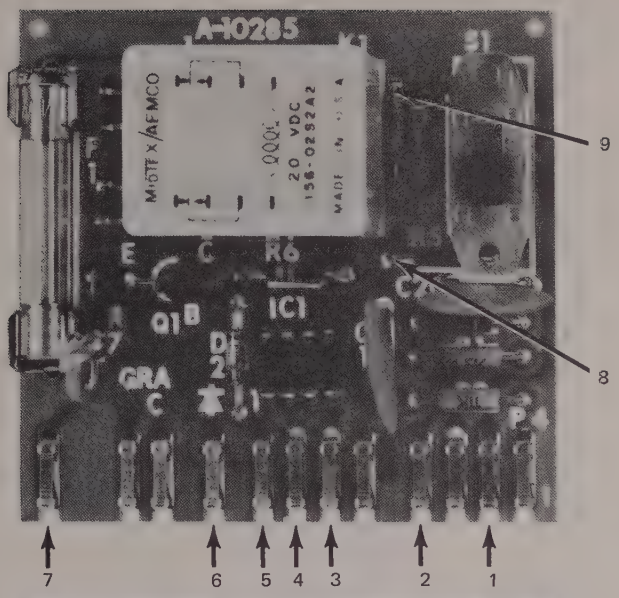


Figure 8.14. Deviation Alarm (A-10285)

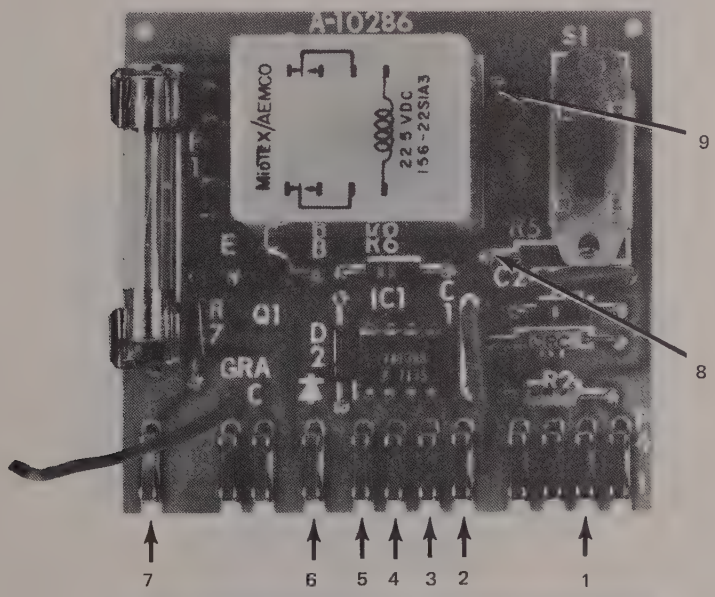


Figure 8.15. Process Alarm (A-10286)

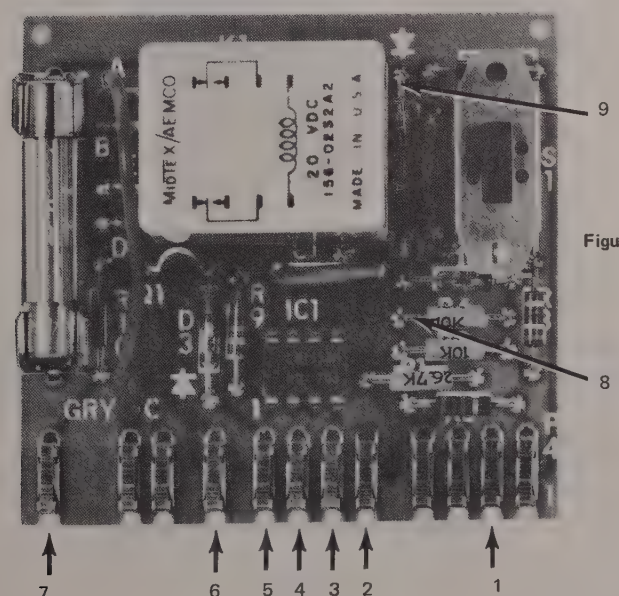


Figure 8.16. Deviation Band Alarm (A-10416)

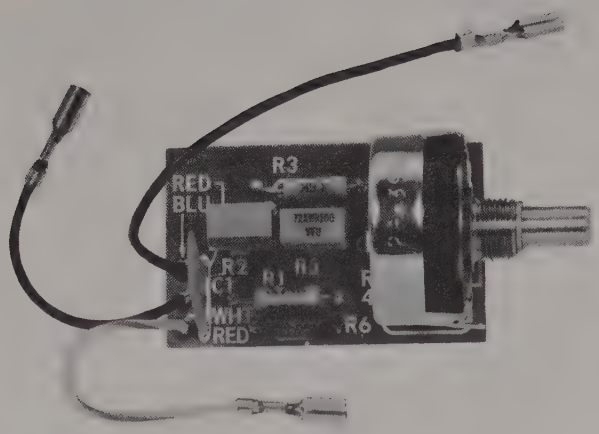


Figure 8.17. Analog Setpoint (A-10503)

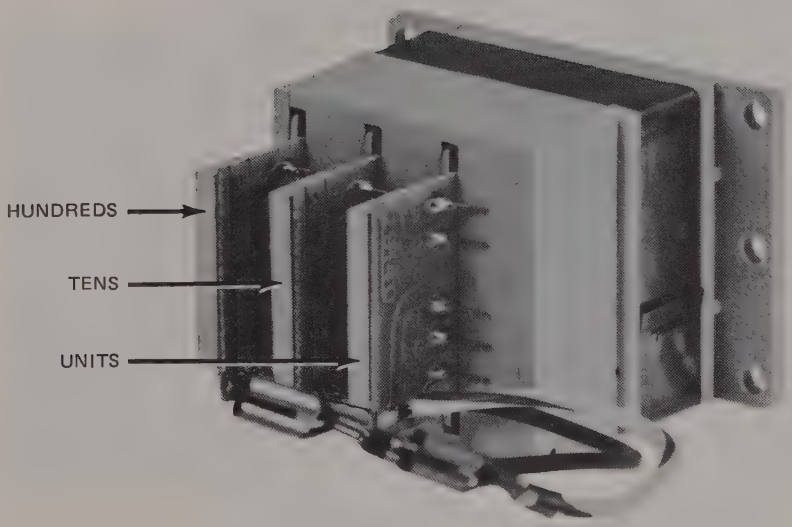


Figure 8.18. Digital Setpoint Assembly (See Table 11.2 & 11.3)

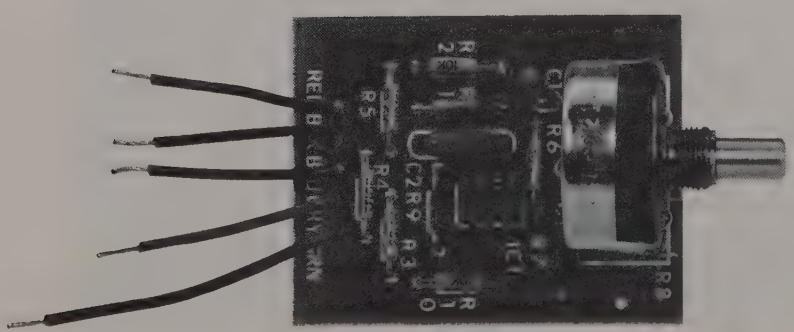


Figure 8.19. Trim Setpoint (A-10278)

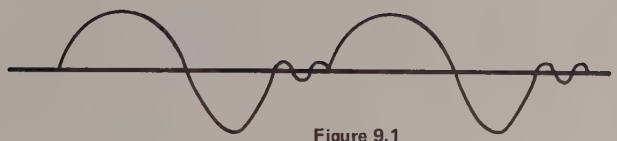


Figure 9.1

Figure 9.2

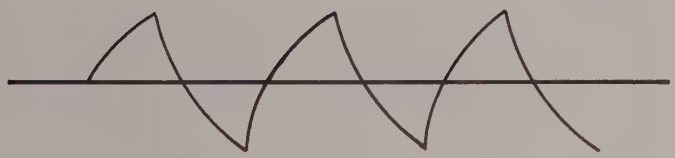


Figure 9.3

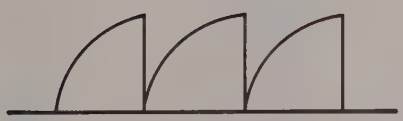


Figure 9.4

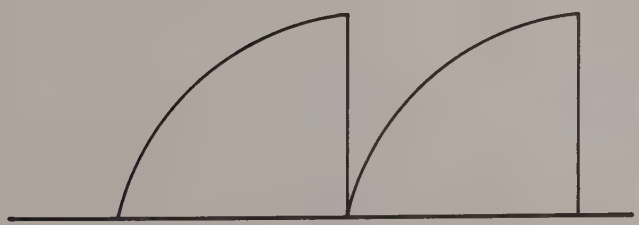
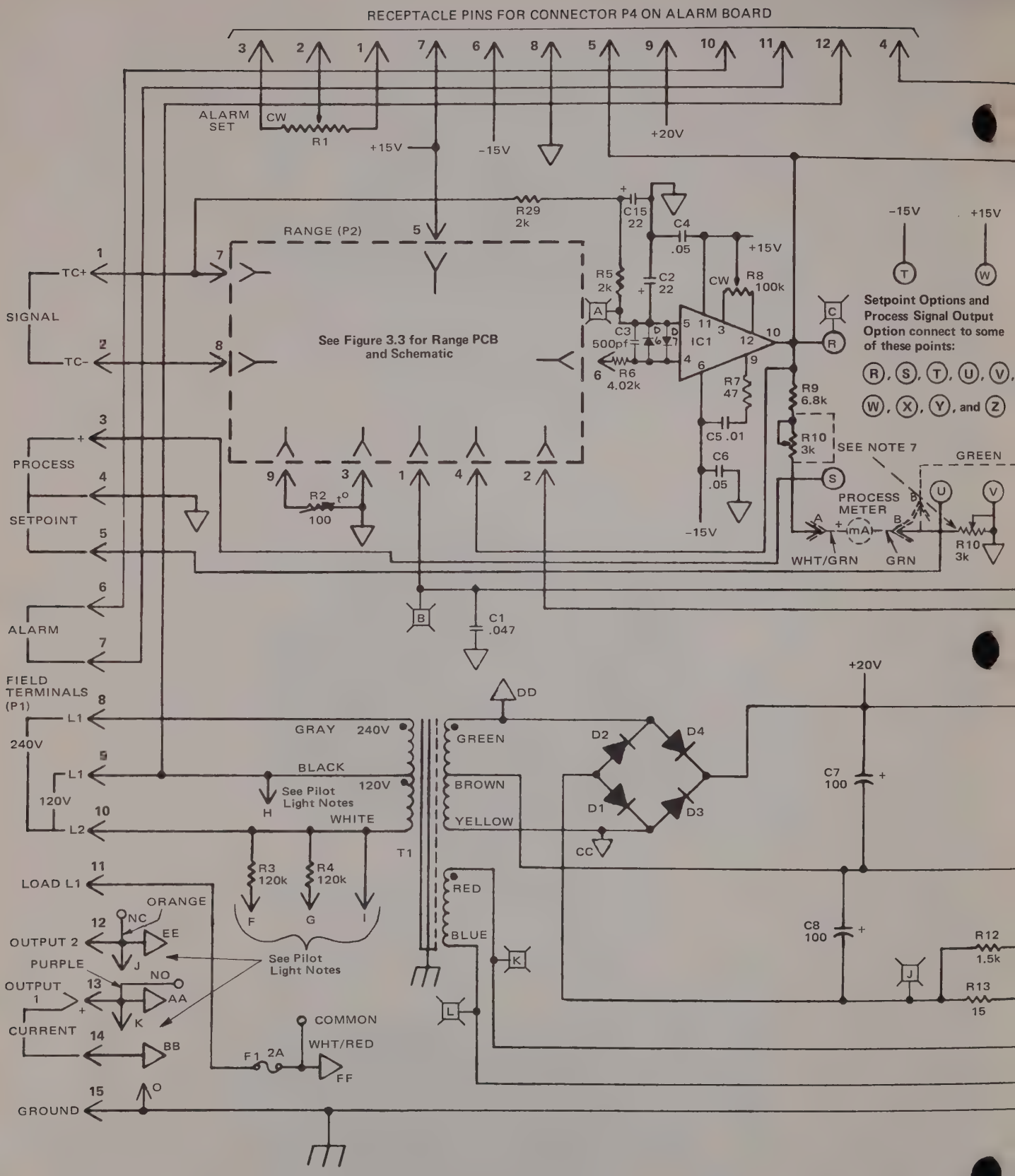


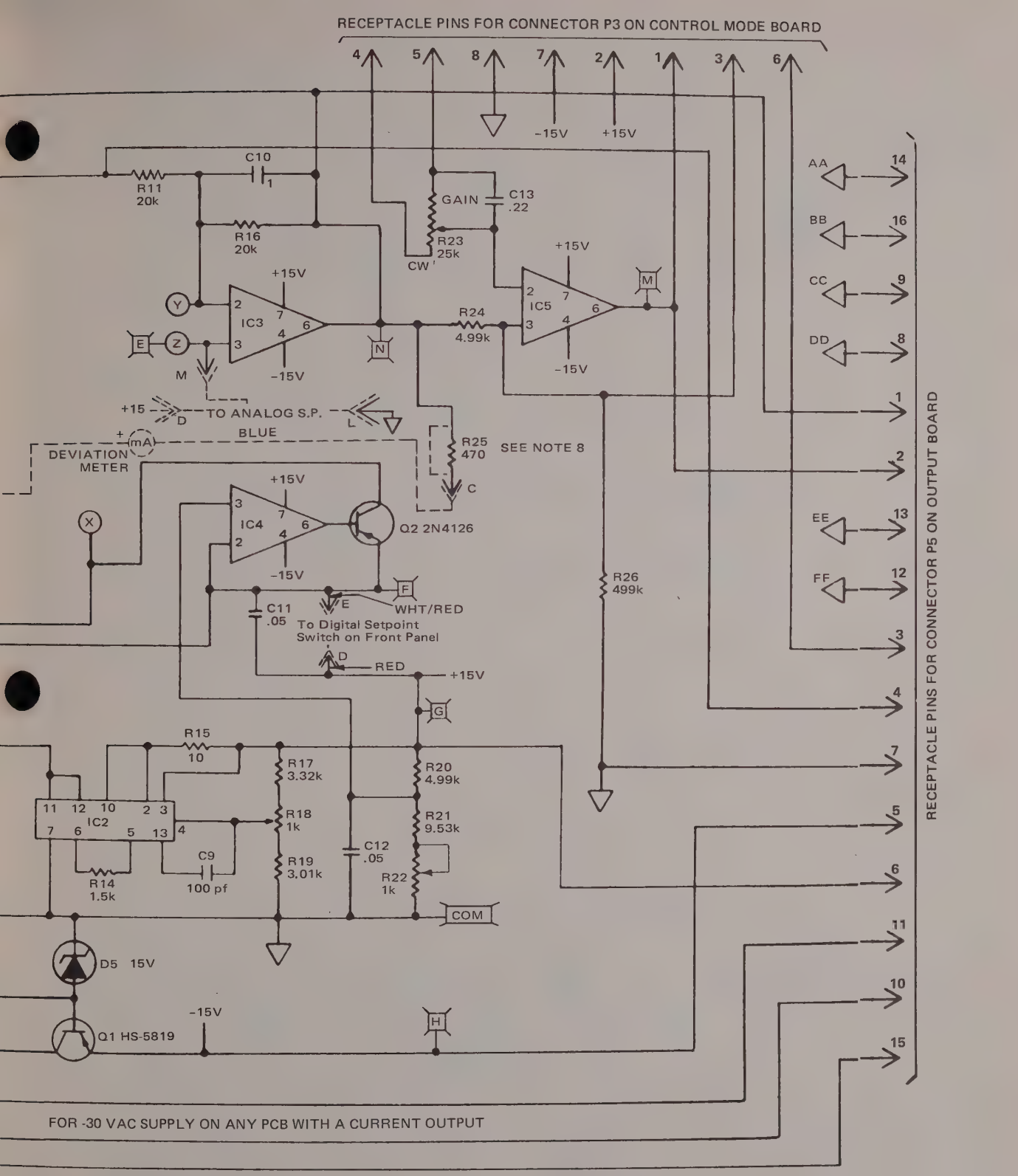
Figure 9.5



10. SCHEMATICS

(Pages 22 thru 30)

Figure 10.1 Main Board Schematic



Pilot Light Notes:

1. For single time prop. or single on-off outputs, amber light is connected between pins G & K.
2. For dual time prop. or time prop. + on-off outputs, white light is connected between pins F & J and amber light is connected between pins G & K.
3. For current output, amber light is connected between pins G & H.
4. For current + on-off or current + time prop. outputs, white light is connected between pins F & J and amber light is connected between pins G & H.
5. For limitrol red light (left) is connected between pin G and N.C. contact of limitrol relay. Common of limitrol relay is connected to pin H.
6. For optional alarms, red light is connected between pin I and pins D N.C. or E N.O. on alarm board.
7. In later models, R10 repositioned.
8. In later models, R25 deleted.
9. ⊡ Test Points.

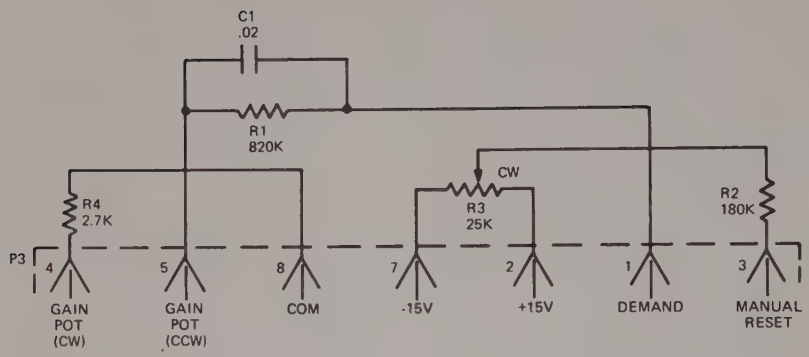


Figure 10.2. Proportional plus Manual Reset (A-10280)

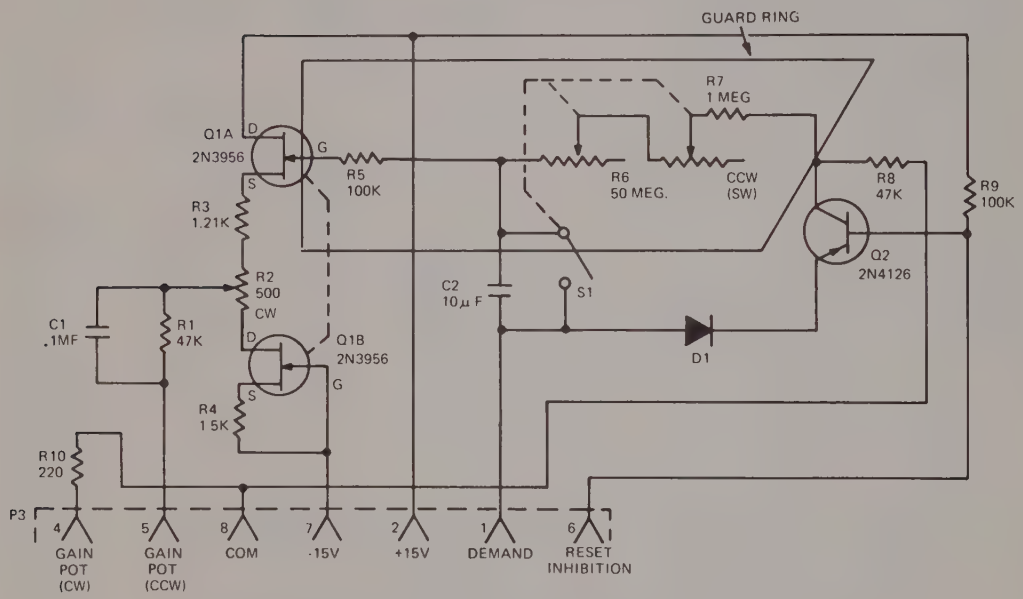


Figure 10.3. Proportional plus Integral (A-10281)

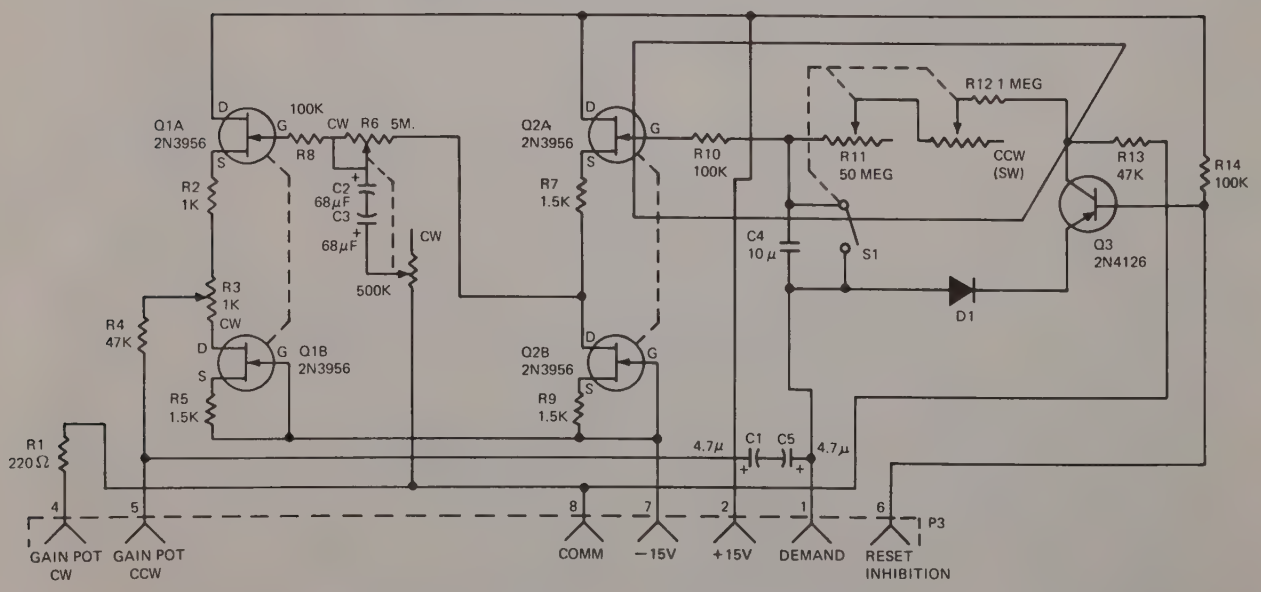


Figure 10.4. Proportional plus Integral plus Derivative (A-10514)

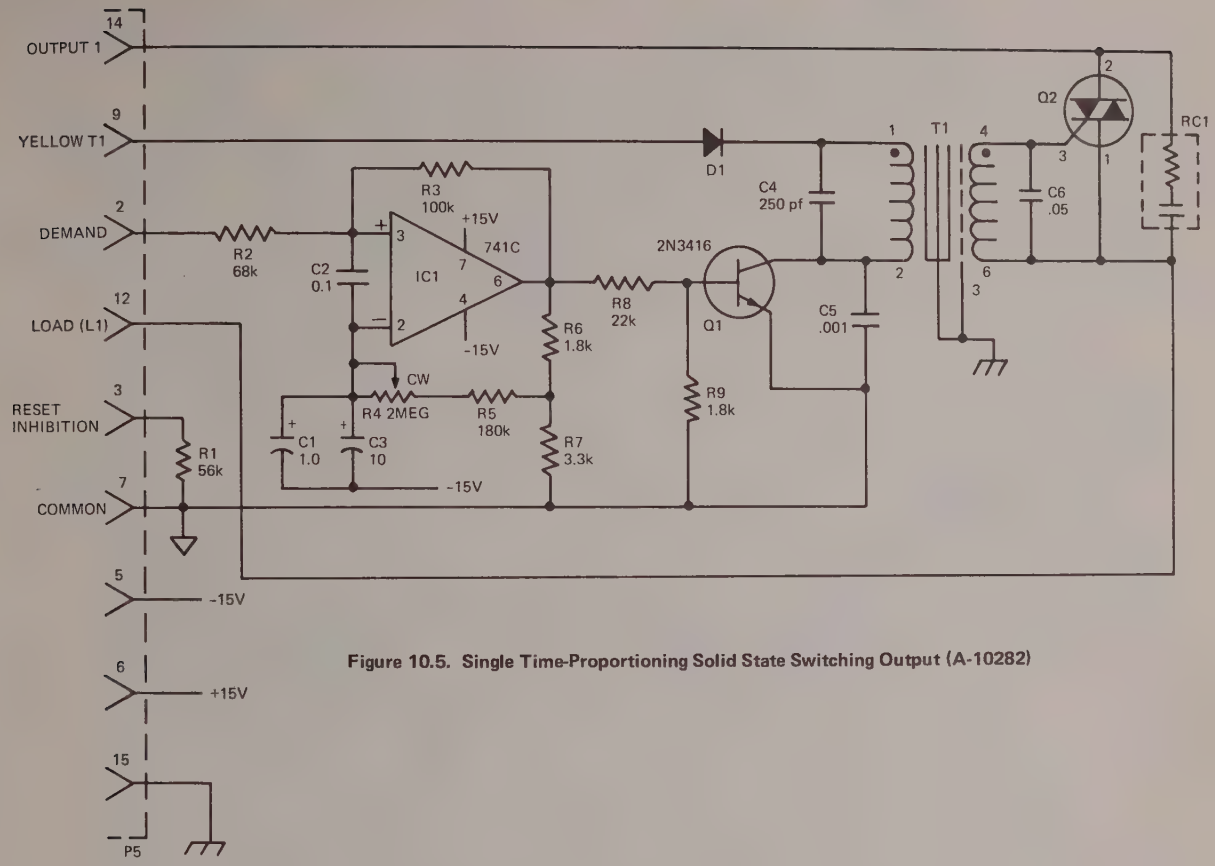


Figure 10.5. Single Time-Proportioning Solid State Switching Output (A-10282)

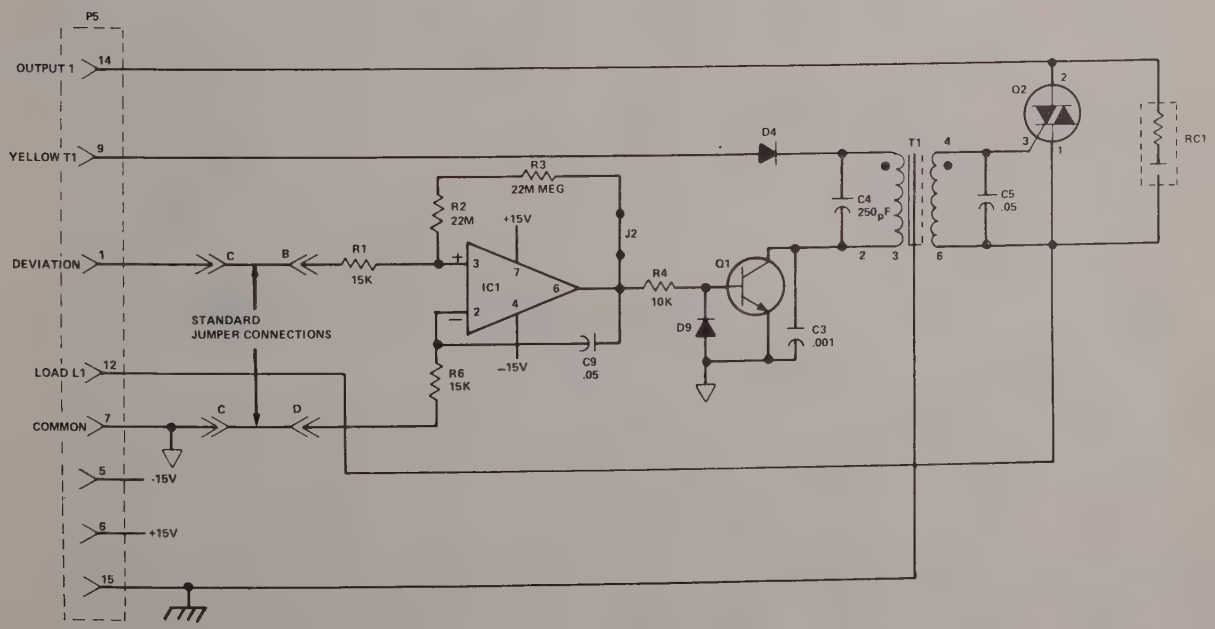


Figure 10.6. ON-OFF Output (A-10335)

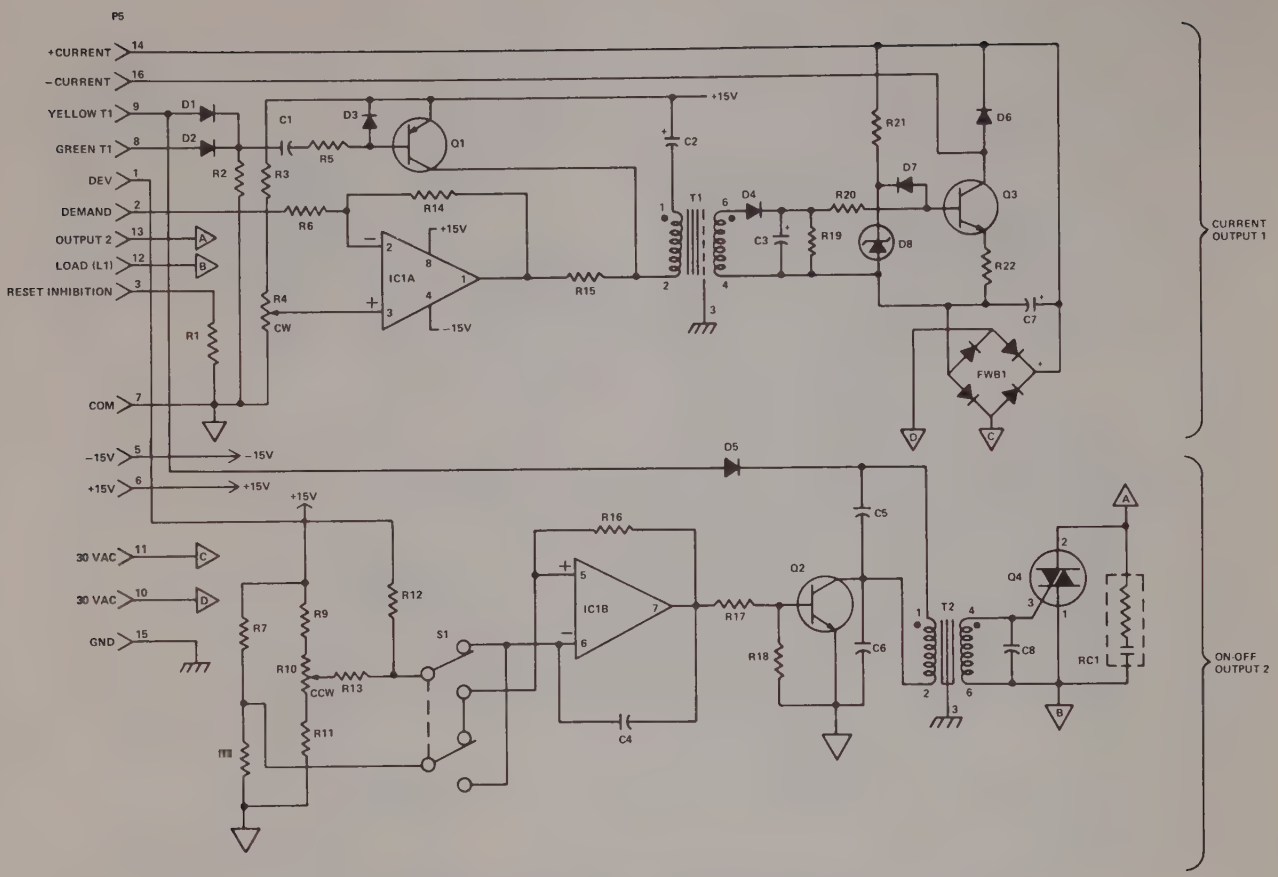


Figure 10.7. Current Output and ON-OFF Switching Output (A-10338 & A-10339)

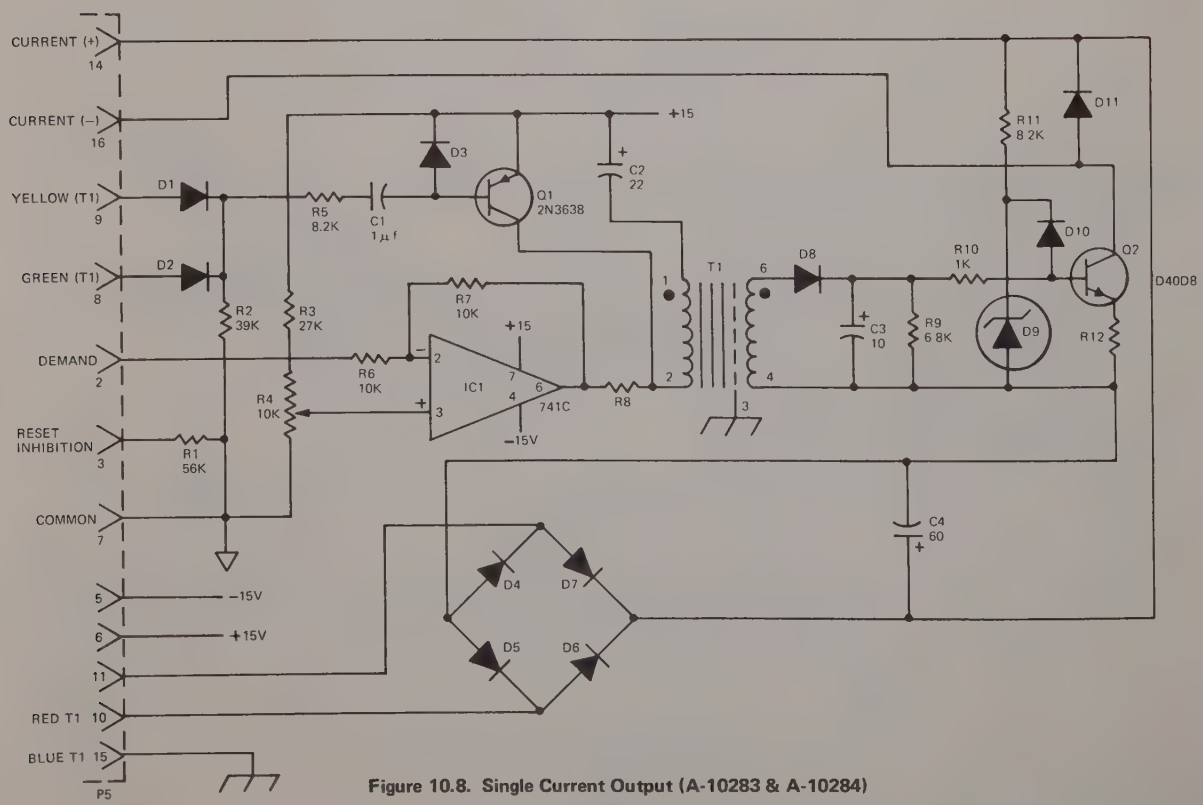


Figure 10.8. Single Current Output (A-10283 & A-10284)

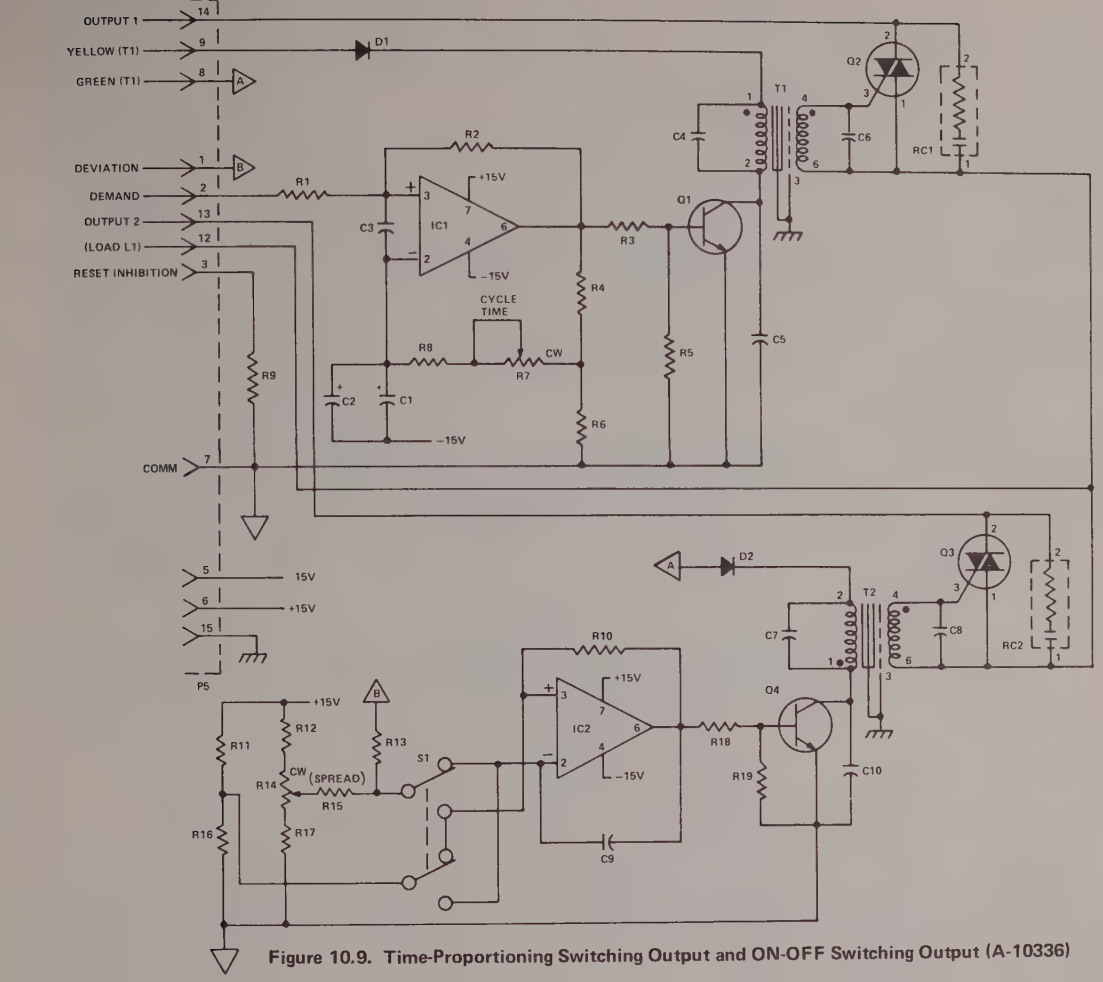


Figure 10.9. Time-Proportioning Switching Output and ON-OFF Switching Output (A-10336)

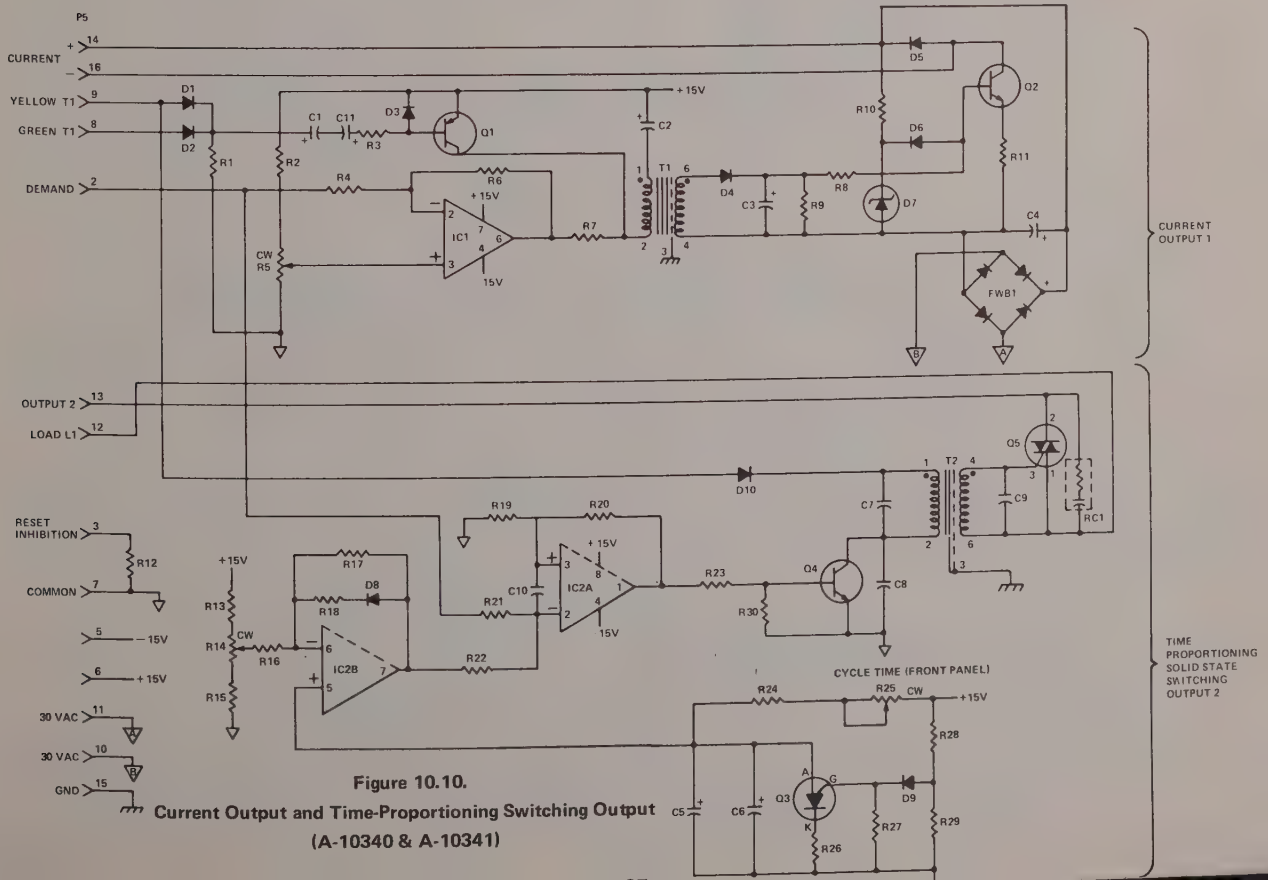


Figure 10.10.
Current Output and Time-Proportioning Switching Output
(A-10340 & A-10341)

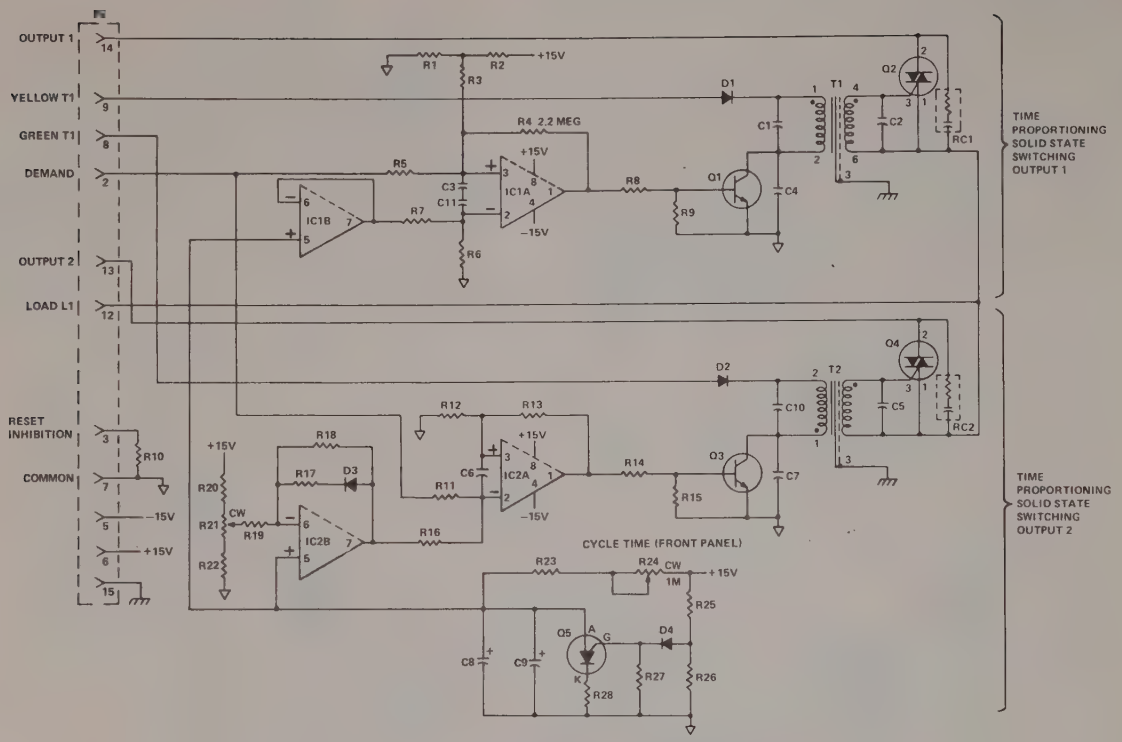


Figure 10.11. Dual Time-Proportioning Switching Outputs (A-10337)

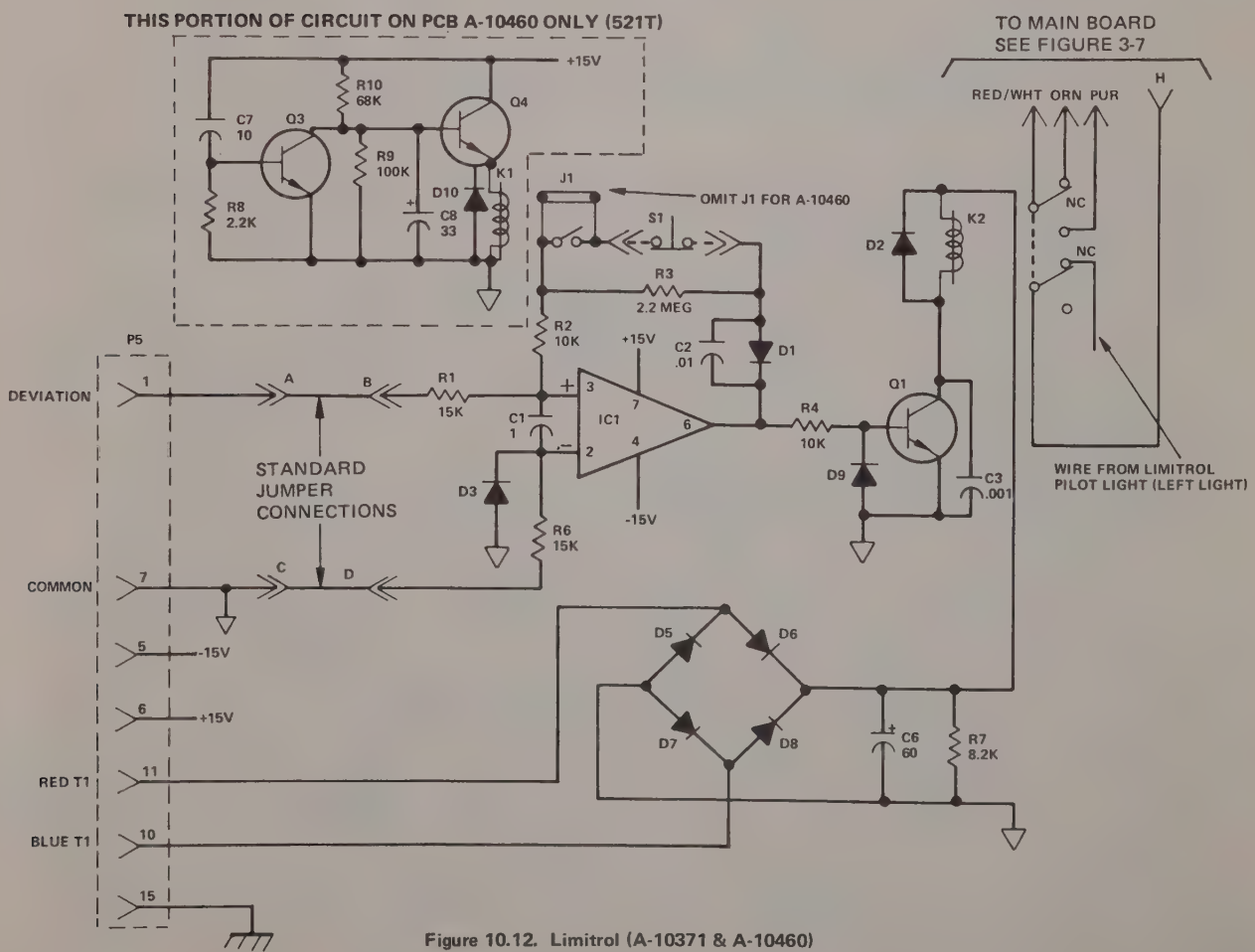


Figure 10.12. Limitrol (A-10371 & A-10460)

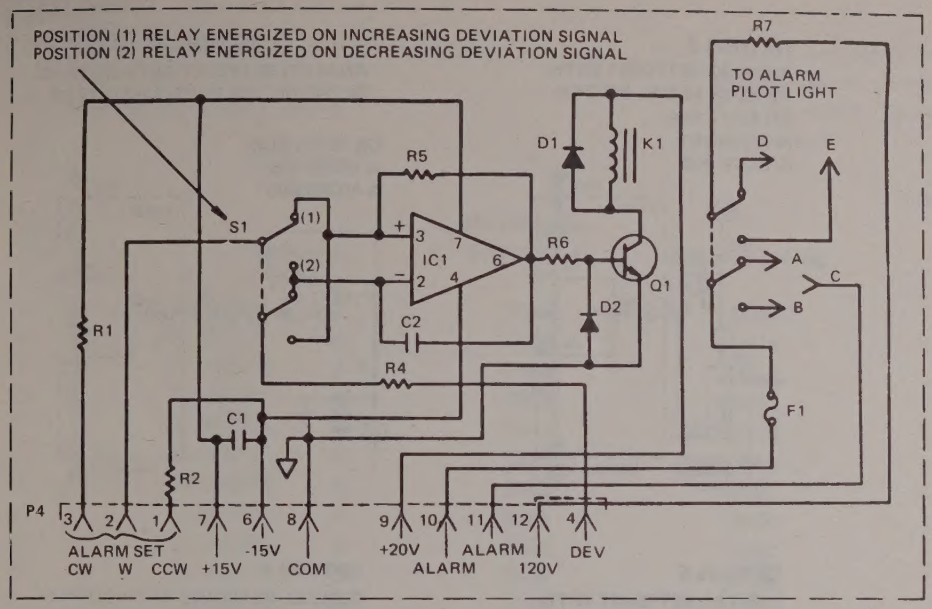


Figure 10.13.
Deviation Alarm (A-10285)

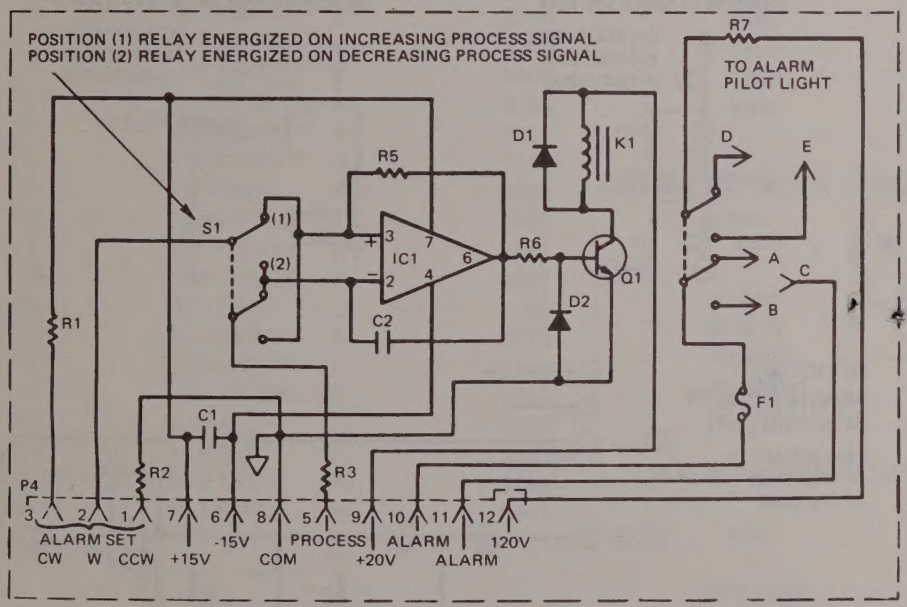


Figure 10.14.
Process Alarm (A-10286)

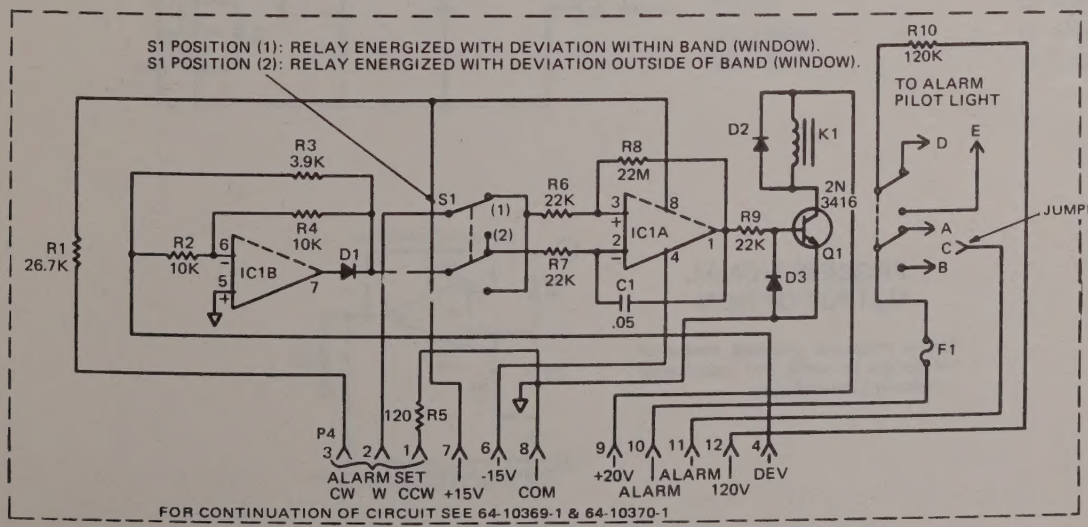
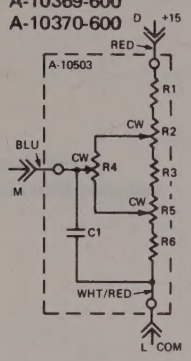


Figure 10.15. Deviation Band Alarm (A-10416)

OPTION 1

ANALOG SETPOINT

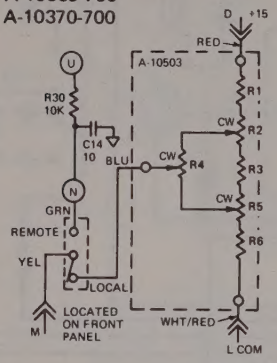
ON MAIN PCB:
A-10369-600
A-10370-600



OPTION 2

ANALOG SETPOINT WITH REMOTE-LOCAL SWITCH

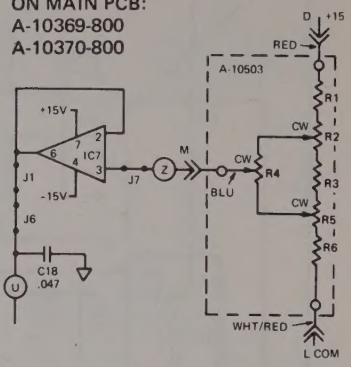
ON MAIN PCB:
A-10369-700
A-10370-700



OPTION 3

ANALOG SETPOINT WITH OUTPUT SETPOINT VOLTAGE AVAILABLE

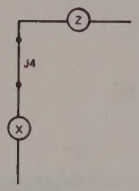
ON MAIN PCB:
A-10369-800
A-10370-800



OPTION 4

DIGITAL SETPOINT

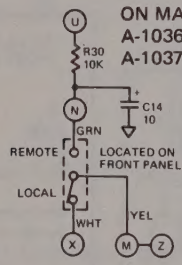
ON MAIN PCB:
A-10369-100
A-10370-100



OPTION 5

DIGITAL SETPOINT WITH REMOTE–LOCAL SWITCH

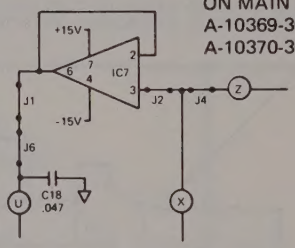
ON MAIN PCB:
A-10369-200
A-10370-200



OPTION 6

DIGITAL SETPOINT WITH OUTPUT SETPOINT VOLTAGE AVAILABLE

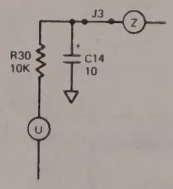
ON MAIN PCB:
A-10369-300
A-10370-300



OPTION 7

REMOTE SETPOINT

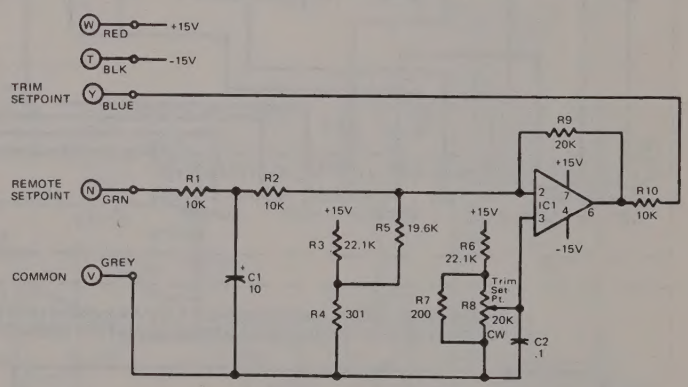
ON MAIN PCB:
A-10369-400
A-10370-400



OPTION 8

REMOTE SETPOINT WITH TRIM (△T)

FOR MAIN PCB:
A-10369-500
A-10370-500



PROCESS SIGNAL OUTPUT OPTION

Unless otherwise specified, resistance values are in ohms and capacitance values are in microfarads.

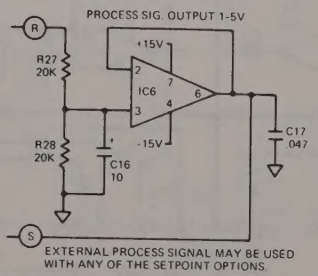


Figure 10.16. Setpoint Options

11. TABLES

11.1 PROCESS METER SCALES

Table 11.1

Range Code	Range		Part Number S-5XXXX-40
15	0–600°F	J	3864
16	0–800°F	J	3356
17	0–1000°F	J	3358
22	0–400°C	J	3355
23	0–500°C	J	3441
27	0–800°F	K	3356
30	0–2000°F	K	3360
32	0–800°C	K	3357
33	0–1000°C	K	2356
37	0–1600°C	S	3359
39	0–1600°C	R	3359
106	0–1000°C	S	2356
153	0–1600°C	K	3359
185	200–1200°C	K	3409
207	0–1000°F	K	3358
218	1000–3000°F	S	3363
219	1000–3000°F	R	3363
276	0–1000°C	R	2356
306	0–500°F	J	3857
521	500–1500°C	R	3361
1395	500–1500°C	S	3361
1590	50–150°F	Cu	1590
2220	0–3200°F	B	2220
2411	200–1200°F	K	3400
3150	500–2500°F	K	3362
3689	0–800°F	Pt	3356
3690	0–1000°F	Pt	3358
3693	0–400°C	Pt	3355
3694	0–500°C	Pt	3441

11.2 To check out digital switch assembly, use Table 11.2 and connect an ohmmeter to the two wires coming from the switch. Disconnect wires from main printed circuit board.

Table 11.2

Setpoint Setting	Resistance
0000	Open Circuit
0001	4 M ±10%
0002	2 M ±10%
0004	1 M ±10%
0008	.5 M ±10%
0010	400k ±1%
0020	200k ±1%
0040	100k ±1%
0080	50k ±1%
0100	40k ±.5%
0200	20k ±.5%
0400	10k ±.5%
0800	5k ±.5%
1000	4k ±.5%
2000	2k ±.5%

11.3 DEVIATION METERS (COMPLETE METER)

Scale	Barber-Colman P/N
50-0-50	36-093-100
30-0-30	36-093-200
100-0-100	36-093-300
200-0-200	36-093-400
10-0-10 (%)	36-093

11.4 DEVIATION METER SCALES ONLY

Scale	Barber-Colman P/N
10-0-10(%)	19-1940
30-0-30	19-1940-100
100-0-100	19-1940-300
200-0-200	19-1940-400

MP MASTER
MA32114

BARBER COLMAN
INDUSTRIAL INSTRUMENTS DIVISION
ROCKFORD, ILLINOIS, U.S.A. 61101

FEBRUARY 1973

LITHO IN U.S.A.